AVIATION

A McGraw-Hill Publication . . . Est. 1916

The Oldest American Aeronautical Magazine

EDWARD P. WARNER, *Editor*

LOUIS F. STOLL, *Publishing Director*

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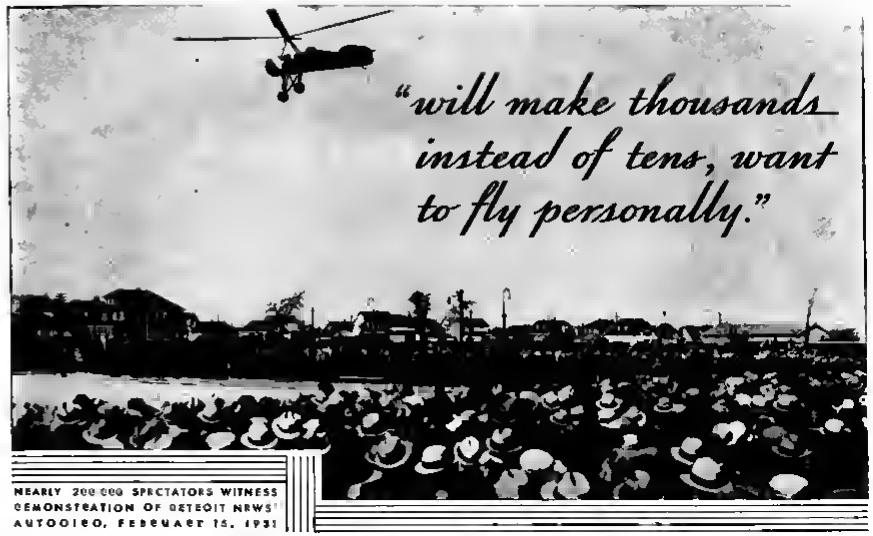

NEARLY 200,000 SPECTATORS WITNESS DEMONSTRATION OF DETROIT NEWS' AUTOGIRO, FEBRUARY 15, 1931

Characteristics

The Autogiro differs basically from all other heavier-than-air craft in the source of its lifting capacity. This lift is given primarily by four rotating blades which take the place of the familiar wings of an airplane. There is no time when this supporting rotation of the blades can be stopped while the machine is in the air, as their motion is produced solely by wind pressure caused by the movement of the Autogiro in any direction, climbing, level flight, gliding or descending vertically. The supporting rotation of the blades is entirely independent of the engine, whose sole function is to propel the Autogiro.

The Autogiro presents flying characteristics hitherto impossible. It can take off at low speed after a very short run, and immediately assume a steep-climbing angle. It can fly well over 100 miles per hour or as slowly as 25 miles per hour. It can be brought momentarily to a standstill and hover. It can bank and turn slowly without fear of loss of forward speed. It can glide or descend vertically at a speed less than that of a man descending in a parachute, and with virtually no forward speed even with a dead engine. Above all, it cannot fall off into a spin from a stall. As a result, little operating skill is required.

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*"A relatively small proportion of the present industry will suffice to supply all the needs of a normally expanding air transport activity and take care of military demands. The big business must come from the individual buyer."**

The Autogiro was conceived and developed especially to meet the requirements of the private owner market.

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The Autogiro Company of America is not a manufacturing or selling company. It is solely an engineering and licensing organization. It owns and controls, exclusively, all Autogiro patent rights in the United States. Manufacturing companies of high standing will be licensed to build Autogiros with the full cooperation of our engineering staff. Present licensees are: Buhl Aircraft Company, Detroit, Mich.; Kellett Aircraft Corp., Philadelphia, Pa.; Pitcairn Aircraft, Inc., Willow Grove, Pa. . . . We are now prepared to arrange demonstrations to acquaint the industry with Autogiro principle, design and operation, and to discuss production privileges.

* *Italicized statements quoted from recognized authorities, names on request.*

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—make the Aircraft Market in SOUTHERN CALIFORNIA!

THE United States Department of Commerce Air Bulletin dated April 15, 1931, shows that there are more aircraft, more pilots, more civilian fliers, more aviation mechanics, in California than in any other state in the Union, and 70% of the air activity of California is in Southern California.

		PILOTS						
	Air craft	*Glid ers*	*Trans- ports*	*Ltd Com*	*Indus- trial*	*Pri vate*	*Total Pilots*	*Glider Pilots*	*Mechcs.*
CALIFORNIA	1169	242	995	227	24	1640	2886	79	1668
NEW YORK	1157	115	532	184	10	861	1587	23	881
ILLINOIS	687	63	385	124	7	457	973	16	555
OHIO	588	101	344	115	0	376	835	13	513
PENNSYLVANIA	509	40	238	136	9	463	846	2	403

In addition to the largest market per capita for airplanes for civilian and transport use, Southern California offers these decided advantages for the operation of an aircraft factory:

Unsurpassed climatic and flying conditions
Well situated plant sites on most favorable terms
Lowest building and maintenance costs
Favorable conditions for open air work
Cheap and abundant electric power, natural gas, and water

Planes pictured in this advertisement are from Howard Hughes' magnificent motion picture "Hell's Angels."

These advantages are aiding local manufacturers of aircraft. Such names as Douglas, Lockheed, Kinner, Emsco, Bach, Northrop, are known throughout the country for their accomplishments. These advantages are open to you also, and we would welcome the opportunity of being of service in bringing them into play in your behalf.

The Industrial Department of the Los Angeles Chamber of Commerce will gladly furnish you complete detailed surveys and full information upon request and without obligation.

LOS ANGELES COUNTY
Flying All-Year

ON THE AIRWAYS TO-DAY

—as on the highways for the last 30 years—

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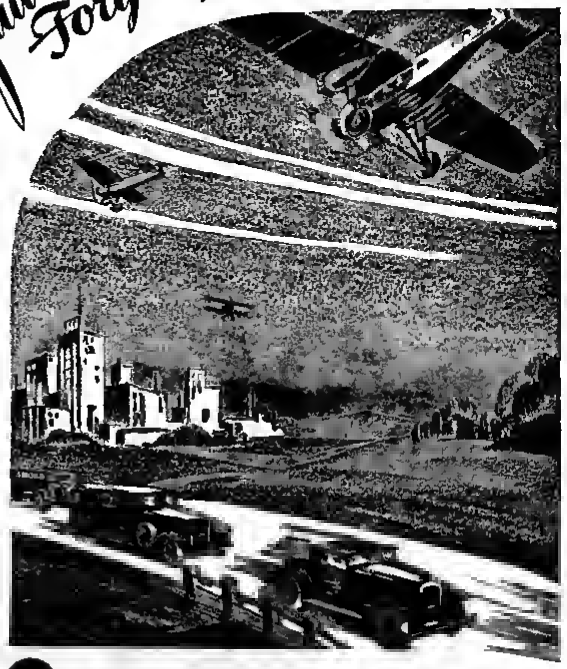

WYMAN-GORDON WORCESTER, MASS. AND HARVEY, ILL.

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Cooperation and an unhappy experience

IN Owen Johnson's delightful stories of Dink Stover and Doc Macnooder and their compatriots, written from the schoolboy's point of view, members of the school faculty were invariably referred to as "the natural enemy." In some quarters in the aircraft industry there is an unfortunate tendency to view the Department of Commerce as deserving that title. The acts of the Aeronautics Branch are belligerently assailed, often without taking the trouble to investigate the facts as they lay before Secretary Young and guided his hand, and even without sufficient inquiry into the truth of some alarming report about what the Department has or has not done.

There are certain fundamentals in the situation. The first is that, by agreement of all civilized countries, some sort of regulation of aircraft is necessary. The second is that whatever body is charged with the work of regulation will be subject to public attack whenever accidents occur. The third, the natural corollary of the other two, is that the task is an exceedingly difficult one, that the responsible authorities have almost literally to walk a tightrope, and that they are inevitably the subject of constant suspicion and frequent bitter criticism.

The task becomes more difficult, and its performance less effective, if the responsible department must go it alone. It becomes easier, and more effective, if the cooperation of the industry is invited and accorded.

Cooperation takes many forms, but one or two of them are of special importance at the present time. One of the most obvious needs is that the government officials charged with aircraft regulation, in this country the Aeronautics Branch of the Department of Commerce, should invite the attention of the manufacturer of equipment to any defect that the government officials find to exist or to develop in the course of operation. That is of particular importance when the defects are merely suspected, or when a mishap has occurred and the cause is as yet uncertain. Then, more than at any other time, the direct assistance of the builder of the equipment concerned is needed. It has been the regular practice of the Department of Commerce to call for it promptly, and to seek the manufacturer's continued participation until all mystery has been cleared away from the material factors in the accident. It has been a policy deserving of continuance, and of the strongest commendation.

There is a further specification, quite as obvious. In justice to the manufacturers, the operators, and the sensibilities of the traveling public, and in the interest of the good relations between the Department and the industry, any premature alarms should be avoided. When

material defects are found, whether they have actually led to an accident or whether they have been detected before actual harm has resulted, the necessary remedies should be determined with the manufacturer's assistance, and they should be applied to all machines in service. There should be no public announcement in any such case until it is possible to be very specific. We have been and we still are, in favor of making public report of the material causes of accidents when they have been determined, but we are unalterably opposed to any general release before investigation is complete. The effect is merely to arouse public alarm and curiosity without quieting the former or satisfying the latter, and without any compensation in the way of technical information on the measures that should be taken by the industry to avoid a recurrence of the same trouble elsewhere. Information of that sort is worthwhile only when it is complete.

It has been the Department's regular policy,—much more constantly than is generally realized in the industry,—to handle these matters as quietly as possible in the early stages on an investigation of suspected material defects, and to handle them with manufacturer assistance. It is a wise policy. It should be continued and the industry, including the transport operators, should cooperate to the utmost in making it effective.

The preceding paragraphs have purposely been made very general, but it will be obvious to everyone that they grow out of the recent excitement over the status of a group of Fokker transport planes. We have no intention of attempting to review the history of that unhappy episode. It was unhappy from every point of view. It was of no one's seeking, and it did no one any good.

It is, however, possible to draw one definite conclusion. The matter went too far simply to be allowed to drop into oblivion. There has been enough rumor and enough vagueness of statement about "certain aerodynamic changes" and static tests. There ought now to be an agreed statement of facts, a statement which will appear as the joint product at least of the Department of Commerce and the manufacturer concerned, and preferably also of the operators actively interested. Too much has been said to close the subject by a sudden fall of silence. Everyone, both in the industry and in the general public, is now entitled to know all about it. There should be no personalities, and no recapitulation of argument about who did what or about how much better it might have been if they had done or said something else. All that is water over the dam. What ought to be provided now is a plain statement of fact—of what tests were made, why they were made, what they showed, and just what modifications have been made as a result. It is not to satisfy any idle curiosity, or to keep an unpleasant dispute alive, that we seek such a statement. It is because it seems to us that a complete clearing of the record is the absolute minimum that the parties most directly concerned ought to want, and are entitled to demand, in justice to their own reputations.

That Newark case

THE past year has been filled to overflowing with notable judicial decisions defining the legal position of aircraft. The Worcester Airport case was important, and a little disturbing. The Cleveland Airport decision was much more important because more definite, and very emphatically dishearteningNow comes the case of the crash of a passenger-carrying plane at Newark a year ago. In its definition of the law of negligence applied to aviation it is of pre-eminent importance among the airplane accident cases so far tried. That the jury brought in the verdict for the plaintiffs against the air transport company in every case gives natural occasion for some alarm among air service operators.

No critical analysis of the judicial interpretation of the evidence presented or of the jury's action in the case can be undertaken here. The defendant company has appealed and has taken exception, quite as a matter of routine, to a number of points in Judge Dungan's charge. With an appeal pending it would be wholly improper for the press to make either favorable or unfavorable comment upon those points. There is no impropriety, however, in focusing attention upon the importance of the case nor in examining the implications of some of the statements of the existing law of the subject as laid down in the judicial charge.

Of the utmost importance was the very plain inference that the operator of an air service, even though passengers be taken only for local flights around an airport, is a common carrier in fact. Accepting a definition from a previous judicial decision, the judge declared common carriers to be "those who undertake to carry all persons who apply for passage." Further discussion plainly implied that exemption was to be had only upon the basis of a deliberate and individual selection of passengers. If passage was to be supplied indifferently to all who paid the fee, excepting those under the influence of liquor or otherwise obviously unfit, it would appear that the court considered the common carrier status to follow as an inevitable consequence.

Although the question did not definitely arise in the present case, it is impossible to glean from the judge's charge any suggestion that the signing of a waiver by the passengers or the printing of a common carrier exemption claim upon the tickets would have affected the status of the operator. It has long been our opinion that the elaborate contracts which most air transport companies now require, with every passenger signing an agreement not to consider the transport company as a common carrier before he is allowed to take his place in the plane, do more harm than good. Their legal value as a defense in event of accident seems to us so questionable that, taken together with the extreme rarity of accidents in transport operations, it cannot be considered to counter-balance the bad psychological effect upon the minds of the passengers. They feel that they are having it thrust upon their attention that the air transport companies consider their own operations to be extraordinarily hazardous and requiring of special exemptions from legal responsibility. At least one large transport company shares our view to such an extent that it has abandoned the use of any elaborate explanations on the ticket and demands no signature from the prospective traveler. There has been nothing in the Newark case to change our view that such a course is wiser than the one more generally adopted.

Common-carrier status is of great importance in the determination of what constitutes negligence, but the definition of negligence given in the charge to the jury at Newark was exceedingly broad, even without reference to whether or not the operator was to be considered as in the common carrier category. The definition is so important that we quote it in full. After the declaration that the defendant company had no unlimited obligation in case of accident and could not be considered as insuring the passengers against the consequences of accident, from whatever cause, the court went on to say "it did owe to its passengers the duty to take reasonable care for their safety; that is, to take reasonable care to provide a plane that was properly constructed, not such a one as to make an accident impossible, but one which was properly constructed according to the state of the science of building airplanes at that time to have it carefully inspected at reasonably frequent intervals, to have it properly maintained and kept in good condition, to provide and have it operated by a competent pilot, and to have it properly and carefully operated." The sting in that definition of obligation is in the final clause. It has been widely argued that the responsibility of a transporter of passengers by air can only extend to the selection of good equipment and the employment of a first-class pilot. The court goes further and requires that the operator shall "have it [the flying equipment] properly and carefully operated." Under that definition the operator is responsible for whatever the pilot does while in the air, and if the pilot, no matter how good his previous record or how carefully his competence may have been tested before employment, is guilty of "improper operation," it would appear to be held to constitute negligence.

From the point of view of the responsibility of the operator other parts of the charge are somewhat more encouraging. The court declared that the passengers in a plane "assumed the risk of all the usual and ordinary perils and risks of airplane travel." He declared that "an unavoidable accident [and therefore one not involving negligence or responsibility] is one which prudence and foresight could not have anticipated . . . a mere error in judgment, when a person is confronted by sudden and unexpected danger which reasonable foresight could not have anticipated, that person . . . would not be responsible for such error in judgment unless that emergency was created by the negligence of the pilot himself."

We shall have occasion to return to this subject later. There will be more cases, and more will be heard of this case in due course. On the face of the record up to the present time it appears that operators must be prepared to be held responsible not only for securing competent personnel and enforcing proper rules of supervision and inspection, but also for the pilot's acting with at least average competence and discretion in every emergency that arises. On the other hand, the responsibility of the pilot, and so of the operator, is to be judged in terms of foresight and not of hindsight. The pilot is responsible only for having taken those courses of action which might reasonably have been foreseen by one of average experience and competence for the employment in which he is engaged. He and his employer are not to be held liable merely because a subsequent examination of the history of the accident reveals that it might have been avoided if the pilot had selected some other course than that which he actually chose.

Agreement at last

THE State Department, after having concealed the Pan-American Navigation Convention in its bosom for almost exactly three years, finally transmitted it to the Senate. The Senate, setting at naught all the gloomy prophecies that had been made about the awful fate to which it would subject the document on arrival, proceeded to ratify it without delay or debate. Incredible as it seems, after our apparently sedulous cultivation of a reputation for remaining aloof from everything, we are now actually fully contracted parties under an international air transport agreement.

It is an important step in advance towards the goal of a general freedom of international air travel, but it is only a limited step. We are rapidly approaching, if we have not actually reached, the point at which it will be impracticable to divide the world into parts in providing for aerial navigation. There is nothing peculiar in the situation of the Pan-American countries which makes it desirable that they organize their mutual communications under a legal framework different from that employed in the eastern hemisphere. There is everything to be said in favor of complete uniformity, with a single document controlling the operations in each hemisphere and between the two. As yet, the Pan-American Convention hardly deserves its name.

Of the thirty-odd independent governmental units of the western hemisphere, scarcely half a dozen have ratified it. In no case are Canada and Newfoundland, or the British, French, and Dutch colonies of the West Indies and of South America, likely to adhere. They

all form parts of empires already parties to the International Convention for Air Navigation drawn up at Versailles in 1919, and none of them seem to feel any compelling urge to supplement that document with another having the same purpose Our adhesion to the Pan-American Convention insures the legal status of our aerial communications with Nicaragua, but for the present at least it leaves our aeronautical relations with the Argentine, Brazil, Chile, and Peru quite unaffected To be sure, those and other leading Latin-American states may climb aboard now, for such has been our reputation for non-ratification that the foreign offices of other countries have been skeptical about taking the time and the trouble to submit international conventions for ratification until our own Senate has taken some sort of affirmative action.

The Pan-American Convention had the advantage of being drawn after commercial aviation was well developed It is easy to pick flaws in the Versailles Convention, still standing essentially in the 1919 form, and point to the superiority of the document evolved at Havana in 1928 It is natural, when confronted with such preposterous examples of Europe emmeshing itself in its own red tape as Mr Manning recited in his recent article in AVIATION, to conclude that we want nothing whatever to do with the Convention under which such absurdities are possible. Examination of the Versailles Convention however, will give proof that the absurdities are less in the document itself than in the temperaments of those who administer it On either side of the Atlantic, and under any sort of legal background a pettifogging official with a taste for minutiae and an exaggerated sense of his own importance will find ways of making a nuisance of himself A judicial examination of both texts reveals no important respect in which the American Convention will be superior to that drawn up in connection with the development of the peace treaty twelve years ago after the latter has been modernized by making the changes agreed upon at Paris in 1929 The amendments await only acceptance by the states already parties to the convention They should be in force within another year When that time comes, we earnestly hope that the United States will lead the nonratifying nations into the fold, and will join with the twenty-seven that have already ratified in a world-wide assembly The Pan-American Convention may then disappear entirely in its present form, or it may sink into a position of furnishing the legal background for certain administrative and technical conferences which may most usefully be organized on a regional basis.

The problems of international law and international policy are usually opaque to the layman, and there are few in the aeronautical industry who have enough taste for such matters to make them the subject of personal study There are many, however, who scorn such formalities and at the same time make almost daily expression of their conviction that the realization of regular trans-Atlantic air service is but a few years away. When such a service becomes technically possible, it cannot function smoothly and economically without a proper legal foundation, nor without the preliminary establishment and continued maintenance of certain international agreements. The subject is too important to be ignored by the industry and the transport operators and left to the State Department, cribbed, cabined, and confined by senatorial veto Every one who believes in, or who expects to have any share in, the promotion of international aviation ought to give a little thought on his own account to the convention and agreements by virtue of which international flying becomes possible After taking thought, which we believe will lead him to the conclusion that no effort should be spared to bring American ideas into harmony with the International Convention at Versailles, every such individual ought to press the matter very forcibly upon the attention of his representatives in Washington Even though no definite action is to be taken until the acceptance of the Paris amendments, it is none too early to begin focussing attention on the subject and spreading information about the Convention's nature and purpose

Speeding up the idea factory

AIRCRAFT maintenance methods have reached a high state of perfection. yet the detailed methods employed in servicing and overhauling planes and engines are constantly changing and being improved upon The mechanic is the man who is faced with a thousand and one little problems from day to day, many of which he must solve on his own initiative In the course of their solution he develops new ways of doing things "Shop kinks" which often are developed and made a part of standard shop practice

These new ideas are of real money value to the aircraft operator It is the gradual accumulation and perfection of novel and improved ways of doing little jobs that brings maintenance costs down and makes profit possible. The mechanic is the man to whom we must look for a majority of valuable new notions and gadgets His initiative in developing "shop kinks" should be encouraged and rewarded. A cash bonus for every mechanic who presents an acceptable improvement over the accepted way of doing things, with a prize and public recognition for the best contribution each month, are the minimum that should be offered by way of stimulation of the mechanic's imagination And when we speak of a "prize," incidentally, we have in mind a reward reasonably proportioned to the value of the innovation for which it is offered. A five-dollar bonus for a development that saves fifty dollars a week is a sop that is worse than nothing The aircraft operator who meets his mechanics halfway will find shop methods improving and maintenance costs dropping in a highly satisfactory manner

News of the Month

The F-10 discussion

Notice of temporary withdrawal from passenger service of 35 tri-engined Fokkers built in 1929 (the F-10 and F-10-A models) on May 4 attracted more public attention than any previous action of the Aeronautics Branch of the Department of Commerce The word was sent out privately on May 2 to the four airlines involved, following the investigation by the Branch of the crash of a Transcontinental and Western Air transport in Kansas March 31. Study indicated that improvement of certain aerodynamic characteristics and a special inspection of maintenance work were desirable

The order precipitated a series of conferences which lasted several days between officials of the Branch and representatives of the Fokker Aircraft Corporation, headed by Anthony H G Fokker, and of the operators affected. Early vague explanations of the cause of the order gave rise to many speculations and rumors in the daily press; statements covering in somewhat more detail the changes desired marked the culmination of the conferences.

The principal change decided upon was the installation of a counter-balance weight on the ailerons. This device, first used by Fokker in Europe a number of years ago and theoretically investigated at the official Dutch aeronautical laboratory, has the object of leaving the aileron statically balanced about its hinge and so eliminating any tendency to aileron flutter In all its comments on its action the Branch has emphasized that there is no reflection on the basic design and original construction of the machines

Inspections and changes are being made by the airlines and the Fokker company, supervised by the Branch officials. Following completion of the engineering changes and inspections, the planes are to be returned to active service. Of the machines involved, American Airways owns 15, Pan American 10, Transcontinental and Western Air 7, and United's system 3.

Routes changed, schedules speeded

Pan American's Miami-Jamaica-Canal Zone route was changed May 1 to include Barranquilla, Colombia. The direct over-ocean distance is shortened Thus, by swinging slightly south of the former trans-Caribbean direct over-water route, points along the northern coast of South America are brought within two days of Miami Consolidated Commodores are used on this line.

Pan American is now in a position to close the gap in its services along the east coast of South America, having received a permit from the Argentine Post Office Department to operate northward along the coast from Buenos Aires. The Rio de Janeiro-Buenos Aires section has not been operated since Pan American took over the interests, with the exception of the South American Mail contracts, of NYRBA.

Transcontinental and Western Air is preparing to speed up its mail service by installing Northrops for the night run between Kansas City and Los Angeles. National Air Transport has been making tests with the same type of machine with the same purpose in view. American Airways is accelerating its New Orleans-Atlanta mail service by the installation of five new Stearmans, one of which has been placed in service.

The Post Office Department has made a number of announcements regarding air mail extensions that are to be made. It is expected that some will go into effect when the new appropriation becomes available, July 1. In the meantime, it has been definitely announced that mail service will be extended by American Airways from Kansas City to Denver, June 1. A Pittsburgh-Washington extension also opens in June.

Two important new airline services have been inaugurated in recent weeks One of special significance is the Columbus-Chicago extension of Transcontinental and Western Air opened on May 1. Thus T & W A goes into direct competition with the New York-Chicago service operated by National Air Transport. The fare is $56

A new service for passengers is the Cincinnati-Atlanta line, operated by American Airways, via Louisville, Nashville and Chattanooga It has been flown regularly with mail for some time. Four Fords will be used to handle the passenger traffic

An additional round trip daily between Oklahoma City and Chicago via Kansas City has been added by Braniff Airways Air Ferries started the Oakland-Lake County Service on April 18, with the Keystone amphibion. Pittsburgh Airways resumed operations of its Buffalo-Pittsburgh passenger line May 1.

Calendar

May 27	Sixth Annual Engineering Research Conference, N.A.C.A. Langley Field, Va.
May 15-31	International Aero Exhibition Stockholm.
June 6	Annual Spring Air Meet, Aviation Country Club of Long Island–Hicksville.
June 8 15	F.A.I. Conference, Bucharest, Roumania.
June 15-20	Third Annual All-Indiana Air Tour starting from Indianapolis.
June 18-27	Third Annual Michigan Air Tour starting from Grand Rapids.
June 29-30	Fourth National Airplane Model League of America Contests, Dayton.
July 4-5	Second Annual Air Meet, Joliet, Ill.
July 4-25	National Air Tour
July 16-19	Second Annual Air Tour of Italy for light planes.
July 25	King's Cup Air Race, England
Aug. 2-16	Second Annual National Soaring Meet, place not determined.
Aug. 29-Sept. 7	National Air Races, Cleveland Municipal Airport.
Sept. 12	Schneider Trophy Contest over Solent and Spithead.
Sept. 13-13	International Air Fete, Los Angeles.

Passenger traffic grows

Twenty-six domestic air mail contractors carried 11,504 passengers in March. Heaviest traffic was on Transcontinental and Western Air planes, which carried 2,353 passengers. Colonial came next, carrying 1,960 between Boston and New York. Eastern Air Transport handled 1,504.

The monthly transport report issued by the Aeronautical Chamber of Commerce shows that in February passenger traffic increased, American lines carrying 20,978 as compared with 17,549 in January. Express increased to 90,941 lb.

Century airlines, the latest high frequency passenger service, reports carrying 933 passengers during the first 30 days of operation, ending April 23, on

its Detroit-Chicago service. Six hundred and forty were carried between Detroit and Cleveland and 376 rede on the Chicago-St. Louis line.

Extensions of Century service have been rumored in various sections. The Pacific Coast hears definitely that E. L. Cord will start up there as soon as equipment can be provided. The first operation will be between Los Angeles and San Francisco.

Transamerican Corporation's Cleveland-Detroit Service across the Lake was patronized by 772 during the first 20 days of April, a new company record. The company's Detroit-Chicago service carried 504 in the same period. New low rates are $.91 cheaper than railroad plus-Pullman fares over this route. Four flights are operated in each direction daily.

Lufthansa expands and economizes

Summer schedules on Lufthansa became effective May 1. This airline system plans a number of interesting refinements to its service. Especially important is the high frequency service to be operated between Cologne and Frankfort, 100 mi. apart. There will be eight round trips daily and the fare will be approximately the same as on the railway.

Because of limited finances, the company this year is operating its international lines in close cooperation with the services of foreign companies. For instance, it is operating jointly with the Italian Avio Line on the Berlin-Rome and Munich-Venice services. The passenger service to Stockholm will be discontinued but mail and freight service will be improved by additional night operations.

The Junkers G-38 is to be used for passenger-mail-freight service between Berlin and London. The Vienna-Constantinople line will be resumed for the summer, making possible transportation of mail between London and Constantinople within 24 hr.

Fares have been reduced on both international and domestic services.

France loosens the purse strings

The French Air Budget, final figures for which have been released, is considerably in excess of the preliminary estimates given in the statistical issue. Almost $88,000,000 has been appropriated for the fiscal year beginning April 1, 1931, an increase of $9,000,000 over the past year. The largest single item is $24,000,000 for the purchase and upkeep of planes and equipment for the air forces. Despite the efforts of one group of legislators the Compagnie Generale Aeropostale, the line through West Africa and South America, receives the same amount as last year—$3,360,000 of the $7,840,000 given in commercial subsidies. The sum of $800,000 appropriated for the "encouragement of touring and sporting aviation" is four times the previous year's allowance.

The budget of the Soviet government for the coming fiscal year includes 150,000,000 rubles for civil aviation. The sum has a nominal exchange value of $75,000,000, but $17,000,000 would be a truer equivalent, measured by local purchasing power.

The provisions of the Canadian government for aviation during the fiscal year 1931-1932 are in direct contrast to these ambitious programs of governmental assistance to the industry. The appropriation of $5,142,000 is a decrease of more than 45 per cent from the past year. Civil operations, which include photographic surveys, forestry patrols, transportation, aeronautical engineering and the control of civil aviation, receive $2,776,000 a decrease of almost one-third. The smallest decrease is made in the appropriation for general maintenance of the Air Force and the training of civil personnel, which are allotted $2,266,000. Air mail routes are to receive $100,000—only one eighth the sum allowed last year—for development expenses, principally the preparation and lighting of intermediate landing fields. In addition to this amount, however, the Post Office Department contributes $1,500,000 to the air mail, only a 20 per cent decrease from the preceding year.

Accidents, non-transport

Following release of an accident report covering schedule operations during the last half of 1930, covered in the May issue of AVIATION, the Aeronautics Branch on May 6 issued a report covering accidents in miscellaneous flying for the same period. Miles flown in miscellaneous operations increased in the July-December period last year as compared with the year before. The total number of accidents also increased, but the number of fatal accidents was slightly less, and the miles flown per accident increased to 50,630. [A full analysis of the figures will be given in the statistical pages in an early issue of AVIATION.]

Accident causes were: Pilots' errors—53 per cent; errors of other personnel 33 per cent; power plant failures 18.58 per cent; airplane failures 11.29 per cent; airport and terrain 9.01 per cent; weather 3.90 per cent; darkness .65 per cent and miscellaneous or unknown 3.24 per cent.

Official Aeronautics Branch medical examiners conducted 8,459 examinations during the first quarter of this year. Of the 2,663 original physical examinations of students 173 were disqualified for physical defects.

New regulations, and offenses against the old ones

Revised Air Commerce Regulations have been issued by the Aeronautics Branch in Aeronautics Bulletin No. 7. Important among the changes is the provision that moral irresponsibility of manufacturer or owner now may result in revocation or suspension of aircraft licenses. Prompted by the increased use of the autogiro type, the Branch now rules that transport and limited commercial pilots may not carry passengers for hire in other than conventional types (fixed wing craft), without special permission from the Secretary of Commerce.

Repairs or reconstruction of a glider amounting to more than 50 per cent must be done by a licensed airplane mechanic and approved by an inspector of the Branch. Drawings and stress analyses are not required.

Licensed craft must obtain permission before making protracted foreign journeys; unlicensed planes shall not be flown in foreign countries.

The Department of Commerce also has issued a revised edition of its requirements for approved flying schools in aeronautics bulletin No. 7-B. The stipulations that a student must complete a course within a given amount of time and that a certain per cent of enrolled students in the school must continue to graduation, provisions that were persuading some of the approved schools to surrender their approved status, have been dropped. It is also provided that a student may count two hours dual cross country time as a portion of his dual test time toward his total flying time. Ground schools not providing flight instruction must affiliate or make suitable arrangement with an approved flight school, or forfeit approval.

Violations of the Air Commerce Regulations during the first quarter of this year increased by 46 over the number for the last quarter of 1930. The number of persons assessed increased by 26. Three hundred and thirteen violations were recorded during the quarter, and penalties were collected in 65 cases.

There were 56 reprimands, 84 suspensions, 25 revocations and 7 denials of licenses; 76 cases were dismissed. The violations were classified as: prohibited acrobatics 60, low flying 40, unlicensed pilots flying licensed planes 23, flying without navigation lights, 10, flying without identification numbers 6, miscellaneous 174.

ON THE WHITE HOUSE LAWN

James G. Ray landing an autogiro on the White House lawn on the occasion of the presentation of the Collier Trophy to Harold Pitcairn for his work in developing the type. This was the second landing of an airplane on the White House grounds on record, the first being done by Lawrence Sperry in a Sperry Messenger.

FOR MEDITERRANEAN DUTY

The first Short Kent all-metal flying boat powered with four Bristol Jupiters ready for tests in England. It was built for the Mediterranean service of Imperial Airways.

Underwriters confer and investigate

Two aviation insurance reports have been made. The most important comes from the Aviation Committee of the American Life Convention, the result of a study to improve the rating of aviation risks.

Recognizing that of two persons with the same number of hours, one may be a decidedly better risk than the other because of personal characteristics, the committee recommends that insurance companies consider rating a risk in accordance with the individual's moral and mental hazards, efficiency, judgment, ability, safe or unsafe personnel practices in the air, and crash record; also would be considered type of plane flown, class of flying engaged in, terrain flown over, field and technical service involved; also number of hours in the air both day and night, and kind of supervision under which the pilot works.

Thus each individual risk would be considered on its own merits and so rated, rather than in accordance with a standard formula. This proposed policy will be offered for discussion at the meeting of the Medical Section of the American Life Convention at Washington, May 19-21, and later at the annual meeting in October.

Barber & Baldwin, Inc., report on a survey of a number of leading life insurance companies regarding their opinion on the effect of flying on ordinary life policies. They say in part: "45 companies responded with a statement of their position. For old policies at present in existence, flying does not invalidate the contract except as to provisions concerning accidental death benefit (the straight amount will be paid but not the double indemnity). Most companies have a one or two year incontestable provision, after which no restrictions exist with regard to the amount of flying. On policies being written at present a certain amount of flying is permitted but only as a fare paying passenger over regularly established airlines. "Occasional" is the word most often used to describe the number of trips." "Occasional" is generally taken to mean from five to twelve trips a year.

The report further states that rates for insuring aircraft against fire in 1930 were 25 per cent lower than in 1929, but fire losses increased heavily in the same period. The cure for high fire insurance rates, the report reminds its readers, lies in rigid discipline and rigid care to be exercised by the industry itself.

Zoning for airport protection

A zoning ordinance recently passed by the city of San Diego limits the height of buildings around Lindbergh field and throughout the city so that no building may be erected which would intercept a slope of 8 deg. 7 min. (one in seven) originating at the boundary line of the field. This is the first straightforward measure of control of building practice in the interest of aviation to be undertaken by any large city.

The new Birmingham (Ala.) $1,000,000 Municipal Airport is being dedicated May 30-June 1. The terminal and administration building is of Colonial design. The hangar measures 120x150 ft. with offices, storage, service, and dormitory space in the wings.

The land cost $1,000 per acre and considerable filling was necessary. The 3,600x100-ft. runway is of coarse, aggregate asphaltic concrete on a crushed stone and slag base. The airport is financed by a bond issue.

More data for the pilot's pocket

Another distinct aid to navigation of our fast-growing airways, this time a medium enabling easier and more efficient use of the ground signalling and information equipment, is being made available by the Aeronautics Branch. This new aid (see illustration) takes the form of a map showing the various facilities, with marginal notations opposite each giving complete data.

These bulletins will be printed on loose-leaf sheets, similar to the familiar airway bulletins of which more than 1,200 have been compiled, and may be kept on file with them.

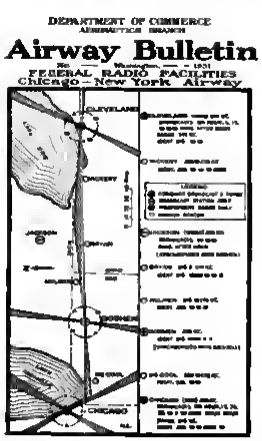
Important recent refinements in airway equipment include installation of visual radio range beacon transmitting stations along the 1,400-mi Los Angeles-Kansas City airway now being flown regularly by Transcontinental and Western Air. The stations are to be in operation by Sept. 1.

An automatic eye from Schenectady

A number of recent technical developments have been announced. Important among them is the General Electric Company's device for detection of airport or airway beacons through fog. Though this device is still an experiment and not available commercially, considerable progress has been made with it.

Its main component is a photoelectric tube, mounted on the fuselage near the tail. In front of it, at a 54-deg angle is a mirror which rotates at 100 r p m. This mirror rapidly reflects light from windows on opposite sides of the plane to the photoelectric tube. This tube is connected with two instruments in front of the pilot—one measures comparative light intensities on opposite side of the plane, and the other measures absolute intensity of the light received.

By means of the first instrument the pilot may know whether the airport light is to be left, right or directly in line with the nose of the plane. The second shows him whether he is approaching or going away from the light. The device can be tuned to resonance with any frequency desired, high enough to avoid interference from the ordinary 60-cycle city lighting, and responds only to lights operating on current of the same frequency. All other lights are eliminated, and by the selection of individual frequencies, it is even possible to identify individual airports or beacons where there would be danger of confusion.



NEW AIRWAY BULLETIN

Facsimile of one of the new supplementary airway bulletins which show the location and characteristics of airway facilities

More about diesels

The Junkers water-cooled diesel aircraft engine is about to be put into production, following a recent successful demonstration flight of the Junkers nine-passenger monoplane equipped with the engine. It is to be used on Lufthansa freight service. The engine is rated at 720 hp at 1,700 r p m., and weighs 1,760 lb., 2.45 lb per hp—approximately the weight of a gasoline engine of like power.

The Diesel airplane engine developed by the Guiberson Corporation of Dallas, installed in a Waco is reported to have been flown from Dallas to Detroit last month on 96 gal. of furnace oil at $.07 a gallon, totalling $5.72. Six quarts of lubricating oil cost $1.20. Fuel consumption was 10 mi. per gal.

England has a new research plane built by Parnall, with adjustable wings and devices for transmitting the forces on the wing structure through struts and wires to dynamometers in the observer's cockpit. Thus the lift and drag are measured directly instead of being inferred from weight and speed.

A hydraulic brake on the propeller makes it possible to take readings during a glide with the propeller stopped and interference from its slip-stream eliminated. The idea of a "flying laboratory" is not new but has never been worked out so thoroughly before. French engineers did much work on direct force measurements at the Villacoublay laboratory about 1921. The Aemstrong Ape, designed especially for stalled flight and landing investigations, was the most notable of previous British attempts in the field.

The importance of shielding transmitting apparatus and radio range beacons as well as receivers, is emphasized by recent tests to discover reason for poor signals from the two-year-old College Park station.

A broken crankshaft has been assigned as the most probable cause for the crash in which Colonel Maddalena, the famous Italian pilot, was killed.

U. S. Akron and Graf Zeppelin

Naming of a number of officers to serve on the U S S Akron marks another step toward the forthcoming test flights next month. Lieutenant Commander Charles E. Rosendahl, veteran of the Shenandoah disaster, former commander of the Los Angeles and later Director of Airship Developments in the Bureau of Aeronautics, will be its commander.

Serious study is being given the proposal to establith an airship service between Holland and the Dutch East Indies. Dr. Hugo Eckener of the Luftschiffbau Zeppelin has been interested in the project by two Dutch steamship lines and is planning a personal investigation of airway and terminal facilities by next winter. The project involves direct competition with K L M., the Dutch subsidized airline to the colonies.

To its many accomplishments, the venerable Graf Zeppelin may add a flight to the North Pole some time this year. Such a project has long been cherished by the Aero-Arctic Society, created under the leadership of the late Fridtjof Nansen and Major von Tschudi.

One of the two units of the Amarillo helium plant, operated by the Bureau of Mines, produced 1,297,000 cu ft of airship gas containing 1,271 000 cu ft of helium during March an average of 56 740 cu ft of contained helium per day. This sets a new record. Direct costs for operation and maintenance were $7.78 per 1.000 cu ft.

The British Empire wants a mail plane

Agitation for Empire air mail service has prompted an Air Ministry invitation to British constructors to bid on high-speed mail planes, designed to a new specification. The cruising speed, with 1,000 lb. of mail and crew of two, is to be 150 m.p.h. Range in still air must be 1,000 mi. Structure must be all-metal. Brakes and a tail-wheel are demanded. In general the specification follows closely the line of American developments of the last three years.

The legislative mills grind on

The material immediately following, together with references to legal and legislative matters elsewhere in the news pages is based largely upon the Aviation Law Service prepared by the Commerce Clearing House, Inc., and is made available by the courtesy of that company.

A desire to give aviation all the encouragement possible seems to motivate many legislatures. One of the most popular methods is to take the sting out of the gasoline tax. Idaho plans to devote all revenue from aircraft fuel to the State Aeronautics Fund. North Dakota will refund the tax when paid on airplane gas. Maine combines the two systems, refunding four-fifths and using what is retained for the "promotion of aeronautics." In Florida the attorney general has declared gas shipped into the state, and used exclusively in operating planes in interstate traffic, exempt from both sales and storage taxes.

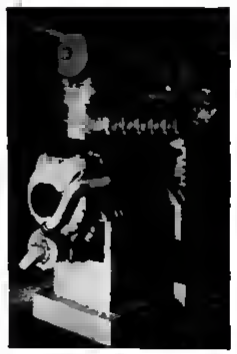
The Maryland legislature has been especially active in the interest of aviation. A lengthy bill has been approved, closely following the precedents of admiralty law in regard to the liability of the owner of air transport ships. Responsibility to the shipper of goods by air, in the event of their loss, would be limited to the value of the aircraft. When the sum so defined is insufficient to cover the compensation claimed, the law of general average is to apply as in maritime practice. (In case of the loss of goods by fire, Acts of God, or as the result of attempts to save life or property, the owner is liable in no way whatsoever, provided he cannot be proven guilty of design or neglect.) Aircraft of five tons gross weight or over, owned by citizens of Maryland and engaged in traffic outside the limits of Chesapeake Bay, are exempt from taxation until 1935, a privilege already granted to large surface vessels.

Maryland has also become one of the few states to place legal responsibility for airway marking upon the individual towns. Each town of over 4000 population must maintain an abbreviation of its name, in 4-ft. letters of chrome yellow, in a conspicuous place approved by the State Aviation Commission and keep the marker floodlighted.

The legislature of Ohio again brought up the Aeronautical Code, previously vetoed by Governor White. The remodelled bill managed to secure gubernatorial approval of its provisions to increase the powers and compensation of the State Director of Aeronautics, and to require federal licenses for all planes and pilots. The defeat by referendum of a constitutional amendment to allow the state of Michigan to engage in the construction of airports necessitated limitation of the scope of a bill recently submitted for the approval of the senate in that state. It authorizes the administrative board to build landing fields only as needed for the state police or other state departments.

Additions continue to be made to the list of states having licensing laws reenforcing the Air Commerce Act. The legislatures of Alabama and Oklahoma have recently approved acts requiring federal license for all aircraft and pilots.

Recent prison riots and outbreaks are indirectly responsible for the latest amendment to the Air Traffic Rules. Suspicion that prisoners might receive aid and information from planes flying low over prison grounds has lead to the regulation that all aircraft flying over federal or state penal institutions must maintain at least a 1,000-ft. altitude.



JUNKERS DIESEL

The Junkers Jumo IV Diesel type engine of 722 hp which was used in a series of favorably reported demonstration flights at Tempelhof airdrome, Berlin, late in April. It was installed in a Junkers freight plane. The engine is to be placed in production soon.

Another bill provoked by current happenings of public interest, and passed by the New York State Assembly, required that passenger planes provide parachutes for all passengers. When submitted to the state senate, however, it was shelved, probably permanently.

The 20th century over-rules the 18th

Transportation in a medium previously restricted to the fowls of the air continues to lead to many differences of legal opinion. The ancient common law of the indefinite extension of ownership down and up, as expounded by Coke, continues to be invoked. Such venerable doctrine must give way to the modern insistence on the right of flight above minimum heights prescribed by law, said a Supreme Court Justice at Mineola, L. I., in disallowing a claim against an airplane as "trespasser."

On the other hand, federal and state laws reinforce each other in prohibiting low flying and the jurisdiction of the two is concurrent, as a student flier discovered when he attempted to argue that the federal statutes rendered those of the state in the same field nugatory and made his trial for violation of the state law invalid.

Another airport nuisance suit. Residents of Armonk, N. Y., complaining against the dust from the Westchester Airport and alleging that it was a detriment to real estate values in the neighborhood, had secured from the Grand Jury an indictment against the airport as a public nuisance. After a week's trial before the county court the jury reported itself hopelessly deadlocked and was dismissed. Unofficially it is said to have been nine to three for acquittal.

An embargo on flying germs

Ways and means of preventing the spread of communicable disease by aerial transportation have been a chief concern of the Pan-American Conference of Health Directors, meeting at Washington and drafting the preliminary provisions for the sanitary control of aviation which, after approval by the International office of Public Health, may be used as the basis of treaties among American nations. The suggestion will be made that bills of health be required only of planes travelling from countries known to harbor such diseases as cholera, Yellow fever, plague, and smallpox. An effort will also be made to eliminate fees for medical inspection of planes, except when a night inspection is necessary. Rat proof airport buildings are considered a necessity in countries where plague is found.

The industry looks up

Optimistic reports issue forth from a number of factories. Eddie Stinson, of the Stinson Aircraft Corporation says: "We contemplate with every assurance the building of 400 planes this year. This total will consist of 50 tri-engined planes for commercial transport use and 350 four-passenger Stinson Juniors."

Eight Northrop Alphas were completed recently and production has begun on the Beta model. A new addition to the factory at Burbenk has been completed, and $25 000 worth of new machinery is being installed.

Boeing is maintaining practically normal production organization of 950 men in the manufacture of military and commercial planes and overhaul work. The company's new all-metal, low-wing, twin-Hornet-engined bomber has been undergoing test by its own and Army pilots.

Curtiss Airplane Corporation has 1,200 men at work at Buffalo all production now concentrated there and the Garden City plant closed.

Walter H. Beech has announced that 28 planes, eighteen of them Juniors, were sold during the week ending May 2. Curtiss-Wright Export Corporation has received orders for seven commercial planes from Mexico and one for Argentina.

The French Wibault Company has joined with Chantiers de Penhoët. The new company, known as Chaintiers Aeronautique Wibault-Penhoët, has a capital of $800 000 and will continue to build the Wibault line of all-metal air-

craft. Vickers has held a license to operate under the Wibault patents in Great Britain since 1927.

French aeronautical exports decreased slightly in 1930, to $8,279,000 from $8,405,000 in 1929. Imports amounted to about $100,000.

Six Junkers W-43's, built in Sweden, and equipped with Gnome-Rhone Jupiters, have been delivered to the Finnish air force.

The Army and Navy buy

Large orders for new planes and engines were given by the Air Corps on the eve of the annual maneuvers. The second largest single order for pursuit planes placed since the war goes to the Boeing Airplane Company, and calls for 135 P-12E planes powered with Wasps and costing $1,541,366.90. To provide power plants for these planes and others a contract has been awarded the Pratt & Whitney Aircraft Company for 202 Wasps at a total price of $1,153,083.77.

Fifteen two-seater pursuit planes—the type designated as YIP-16—have been ordered from Berliner-Joyce. They will be powered with Curtiss Conquerors and will cost $267,436.98. This type is in the advanced experimental, or service test, stage.

A $1,920,510 contract was awarded Keystone Aircraft Corporation of Bristol, Pa., for 25 B-4A bombers, each with two Hornets, and 39 B-6A bombers, each with two Cyclones. Wright Aeronautical Corporation is to build six R-1820-E Cyclones, costing $39,112.86 for installation in three new Fleetster transports and for use as spares.

Fokker Aircraft Corporation is to build three YO-27 observation planes and three YB-8 light bombers,—twin-engined monoplanes with Curtiss Prestone cooled engines and retractable landing gears. They are to be used for service test. They will cost $252,720.43.

Four training planes of a new type are to be provided by Consolidated Aircraft Corporation for $31,103. They will have Continental A-70 engines.

Douglas Aircraft Corporation will supply fifteen more of its O-38's (Hornet-powered observation planes) at a cost of $171,049.20 for National Guard units.

Curtiss Aeroplane and Motor Company is to build 30 Hell-Divers (two-seater fighter-dive bombers) for the Navy at a cost of $440,000.

Financial returns, good and not so good

Barron's Magazine is courier for the most favorable reports for the first quarter of 1931. United Aircraft & Transport showed a profit of $650,000 for the early period, more than two-thirds the 1930 profit for the opening quarter and equivalent to between 20 and 25 cents a share on common stock after preferred dividends had been deducted, as compared with similar earnings of 39 cents a share in 1930. Prospects of increased earnings in the next quarter of 1931 rest chiefly upon the operations of the Pratt & Whitney engine company and the transport subsidiaries. The transport lines brought in 26 percent of the 1930 gross revenues. The new rates on mail contracts, becoming effective on the Boeing line last November, affected transport earnings less than was expected. Increased passenger traffic offset the reduced mail revenues despite an increase of the number of tri-engined craft in operation.

Barron's reports on the North American Aviation Corporation indicate that the income for the first six months of 1931 will equal that of the same period last year. The passenger operations of its transport unit, Eastern Air Transport, have also offset the expected decrease in gross due to new rates for mail under the Watres Bill, passenger earnings in March having been $39,000. Since December, when 507 passengers were carried, mileage flown in passenger operations has almost doubled, and the number of passengers carried more than trebled. The net income of the company for 1930 was reported as $1,911,110, but no statement was made as to the proportion to be accredited to the non-aeronautical subsidiaries, Sperry Gyroscope and Ford Instrument Company.

National Air Transport shows first-quarter earnings of $117,579 after taxes, a net of 18 cents per share. The gross income was up 24 per cent from 1930, but the net fell off 8 per cent. An effect of the Watres Act.

Aviation Corporation stockholders derive some comfort from the announcement of the reduction of losses for the first three months of 1931 to $224,988, as against $954,004 for the same period last year. This is a reduction from 40 cents to 10 cents per share of stock outstanding.

Reports continue to come in of losses incurred by various corporations during 1930. The Great Lakes Aircraft Corporation reports a loss of $1,258,832 for the year. Of this amount $264,847 was charged to inventory adjustments, $429,400 was actual loss from current operations.

Kinner confines itself to a statement of current assets, all the net expenses of the year having been charged to experimental and development expense. This item totaled $1,185,290 as of Dec. 31, 1930, as compared with $485,025 at the end of 1929. Current assets as of Dec. 31, 1930 are listed at $392,923, of which $54,562 are cash and accounts receivable, while current liabilities were charged at $140,779 at that date. However, this indebtedness had been reduced to about $78,000 by April 1, 1931.

Bankruptcies and absorptions

The powers of endurance of many aircraft manufacturers have been taxed to the utmost by the strain of the current depression and some have found it necessary to take steps to handle these unprecedented financial difficulties. The Timm Airplane Corporation of Los Angeles has assigned its assets to a creditors' committee which will attempt reorganization. The receiver for the New Standard Aircraft Corporation has requested permission from the court to sell the assets of the company at public or private sale. Robert E. Cole, receiver for the Mono Aircraft and the Lambert Aircraft Engine Corporations, has filed petition to be allowed to sell the assets of the company to the Luscombe Company of St. Louis for the sum of $56,250. It is understood that the Luscombe Company includes interests previously active in the management of Mono Aircraft.

The American Eagle Company's assets have been sold to a group of the stockholders who will merge the company with Lincoln Aircraft. The new company will occupy the American Eagle plant in Kansas City; will be known as the American Eagle-Lincoln Aircraft Corp.; and will be headed by Victor H. Roos, now president of Lincoln.

Cooperation on patent procedure

At a meeting in Detroit the manufacturers who are partners to the Manufacturers Aircraft Association patent cross-licensing agreement made further arrangements to use its machinery. Any inventions or design developments may be submitted to the association, which will investigate the prior art and handle the details of patenting if that seems desirable. In the case of designs which it is not deemed advisable to patent, their future use by the manufacturer may, if he wishes it, be protected by formal disclosure. A major object of the plan is to provide protection on small developments which would otherwise be allowed to pass without patent action being taken by the manufacturers originating them. An improved permanent record of inventive development in the art is to be secured for the M.A.A. by the passage of this material directly through the hands of its attorneys.

Personnel

Dr. Frederick William Lanchester, of Birmingham, England, pioneer in aerodynamical theory and other phases of aeronautical and automobile engineering, has been awarded the third Daniel Guggenheim gold medal, in recognition of his contributions to the fundamental theory of aerodynamics. The first Guggenheim medal was awarded to Orville Wright, the second to Dr. Ludwig Prandtl, German aerodynamicist and creator of the induced-drag theory.

P. G. Johnson, president of the Boeing Air Transport, Pacific Air Transport and Boeing Airplane Company, has been elected president of Varney Air Lines, a Boeing subsidiary. Lewis H. Mueller, former president, becomes chairman of the board of directors. Walter T. Varney, the founder of the line and former chairman of the board, continues as a member of the board.

W. G. Herron, formerly vice-president of Air Investors and vice-president of Boeing Air Transport, is now vice-president of Alloil Lubricants, Ltd., of Los Angeles.

H. A. Burgess, former Western Air Express general traffic manager, has resigned to become sales manager for Radio Laboratories, Inc., Hollywood, Cal.

David Visel, vice president of Curtiss-Wright Flying Service in charge of sales, has resigned.

Ameha Earhart has been elected vice-president of the National Aeronautic Association, to fill the gap left by the resignation of Robert J. Pritchard of Los Angeles. Mr. Pritchard's resignation was submitted as an incident of the western protest against the long term award of the National Air Races to Cleveland.

Military schooling

The Air Corps is reorganizing its school system. The primary training schools at March and Brooks Fields are to be consolidated at Randolph Field and units from both will be transferred to the new station early in June. The Air Corps Tactical School will be transferred from Langley Field, where it has been resident for ten years, to Maxwell Field late in this month.

Early in May, French army and naval forces carried out combined maneuvers in the south of France, with special emphasis on the use of aircraft for attacking the coast and the naval base at Toulon. The first grand maneuvers of the Italian air force will be held in August.

Air Service Training, Ltd., a project of the Armstrong-Siddeley Company opened at Southampton, England, on April 14. This school has the unique purpose of training pilots for the military air services of other countries in addition to making available civilian courses and special refresher courses for R.A.F. reserve personnel. Practically every phase of flying is covered, even to training in the duties of an instructor. The personnel is distinguished, with a board of directors headed by Air Marshal Sir John F. A. Higgins.

Royal Air Force methods are followed throughout. Instruction on an Avian landplane costs about $30 an hour; on an Avian seaplane about $40. The average cost of the private pilot course including 6 hr. solo time, is about $435. The complete course for foreign service students costs about $1,800.

Flight Lieut. H. R. D. Waghorn, winner of the 1929 Schneider Trophy Contest, died May 7 from injuries received in a vain parachute jump after his plane had gone out of control at low altitude. His death was the forty-first in the Royal Air Force during 1931.

Air Vice Marshal Fenton Vesel Holt, air officer commanding the fighting area, air defense of Great Britain, was killed late in April in a collision. He learned to fly in 1912 and has played a leading part in the development of British military aviation ever since.

JAPAN BUILDS A SEMI-RIGID

This airship made a new world non-refueling endurance record for this type of airship by remaining in the air 60 hr. 1 min. over the Kasumigaura field of the Japanese Navy.

Records

The most interesting flights of recent weeks have been made by Capt. Frank M. Hawks in Europe. His flight from London to Rome on April 22 in 5 hr. 20 min. (892 mi.) and return to the outskirts of Paris in 4 hr. 32 min. created a sensation in European Aeronautical circles. The next day, April 23, he established a new record for the Paris-London trip by covering the distance of 218 mi. in 59 min. On April 30 he flew from London to Dublin, (285 mi.) in 1 hr. 40 min. On May 12 the Texaco Travel Air voyaged from London to Berlin (576 mi.) in 2 hr. 57 min.,—like all his preceding European voyages, a new record.

Miss Ruth Nichols established a new world speed record for women (though not yet homologated) on April 13 by flying the three-kilometer course at Grosse Isle Airport, Detroit, at an average speed of 210.65 m.p.h. She used the same Wasp-powered Lockheed Vega monoplane which she has used in her transcontinental and altitude flights.

New duration and distance records over circuits for light land planes of the first category (two-seaters weighing less than 881 lb. empty) was established in April by two French pilots, Froton and Lavergne, time, 29 hr. 38 min. 45 sec., the distance, 3,467 kilometers (2,153 mi.).

C. W. A. Scott now holds the record for the London-Australia flight. He arrived at Port Darwin 9 days 4 hr. 11 min. after leaving Lympne Airport. The previous record, 9 days 21 hr., was made by Air Commodore Charles Kingsford-Smith last October in his Avian Sport. Scott used a Gypsy Moth. Bert Hinkler's record, made in 1928 in an Avian was 15½ days.

New requirements for private pilots' licenses were issued recently in France. The prospective pilot must be at least 17 yr. of age and have had at least 15 hr. of flight, including dual-control time. He must have made at least 30 solo landings spread over a period of not less than one month. Requirements for annual re-licensing include proof of three hours of flight during the six months immediately preceding.

The Second Annual National Soaring Meet will be held Aug. 2-16. A number of sites are being considered, among them Warwick, N. Y., Elmira, N. Y., and Pittsburgh, Pa.

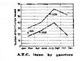
Statistics of the Month

[illegible] regularly each month. Page numbers in the statistical issue are given.

PRODUCTION AND LICENSING
(Page 330)

A STRIKING feature of the chart showing quarterly issuance of approved type certificates is the almost complete consistency of the 1929 and 1930 curves for new types of airplane seeking the approval of the Department of Commerce No less remarkable is the peak in the third quarter of each year. It would more logically be expected at the beginning of the year when new ships are being developed in anticipation of the annual air show in the spring New design activity in 1930, and during the first quarter of 1931, seems to have slacked off to well below the 1929 rate The apparent drop is due at least in part, however, to the growing tendency to keep to standard engine equipment instead of getting four or five A.T.C.'s with as many different engines.

JANUARY 1, 1931 marked the first anniversary of the present system of record-keeping on student permits Only from that point forward is the number of student permits valid significant, giving the number of students nominally under training at any given time There was a peak accumulation of prospective flyers early in January and then the curve dropped sharply. After a gentle rise late in February a new low point was reached the third week in March.

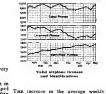


A.T.C. issue by quarters

Since February the total has been very nearly stabilized around 14,850

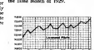
THE increase in total planes evident in March, after a set-back in late April has continued at a higher rate to within tantalizing reach of the 10,000 mark. The curve for licensed planes, turning upward at an unusually sharp angle, is responsible for the larger proportion of the rise, that for identified planes adhering to its tendency to climb at a slower rate.

Equally conservative in its rate of increase is the curve for licensed mechanics, which seldom varies more than twenty in a month The curve for licensed pilots, despite its consistently recurring peaks and valleys, might be straightened to show a very definite monthly increase The last figure plotted this month set a new record.

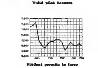


Valid airplane licenses and identifications

THE increase in the average weekly issuance of student permits progressed to a unique position in April For the first time the 1931 curve managed to cross that of 1930, in this case topping the figure for the previous year by almost 10 per cent. The curve for pilot licenses fares less well, however Its direction is upward, but at a very gradual incline, with the average for April, 1931, slightly below even that of the same month of 1929.

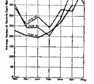


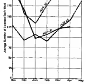
Valid pilot licenses



Student permits in force


Valid mechanic licenses


Student permits newly issued, month by month


New pilots licensed month by month

Contract Air Mail Totals for March, 1932 (preliminary)

Length of route (miles)	21,887
Regular through round trips scheduled	1 122
Miles of service scheduled	2,019 579
Miles of service actually flown	1 600 554
Total weight of mails dispatched (pounds)	724,902
Amount paid to carriers	$1 463,744 92

AIR MAIL AND TRANSPORT
(Page 282)

THE cooperation of the Post Office Department in furnishing March air mail data at an unusually early date enables us to give the report of contract air mail carried during the first quarter of 1931, with figures in the estimate state in only a few instances on the poundage column The totals show in every case a sizable increase over 1930 This is largest for Miles of Service, mileage scheduled presenting a 47 per cent increase over the 1930 total of 3,961,147 mi. The smallest increase is in mail poundage, the weight carried in the first quarter of 1931 being 21 per cent in excess of the 1930 total of 1,701,659 lb In spite of the lower rates offered by the Post Office Department for contract air mail this year, the sum given in compensation to carriers was more than one-fourth larger than in the opening quarter of the preceding year. This compensation was at the rate of 82 cents per mile flown in the first quarter of 1931 as compared with 97 cents in the first and 84 cents in the last quarter of 1930

Contract Air Mail Carried, by Routes, First Quarter 1932*

	Length of Route (Miles)	Regular Through Round Trips Scheduled	Miles of Service — Scheduled	Miles of Service — Actually Flown	Total Weight of Mails Dispatched (Pounds)	Amount Paid to Carriers
1. Boston-New York	200	73	54,500	47 738	30 742	$90,670 53
2. Chicago-St. Louis	276	180	90 360	87,893	15 594	55,601.59
3. Chicago-Dallas	1,070	180	901 650	506 764	107,230	283 545 61
4. Salt Lake City-San Diego	771	90	202,179	253 449	201,112	991 077 17
5. Salt Lake City-Seattle	1,817	90	518,105	288,457	77,821	254,515.70
8. Seattle-San Diego	1,258	90	222,872	216,551	85,215	189 907 72
9. Chicago-Pembina	1,274	208	506,979	284 875	60,680	295 745 81
11. Cleveland-Pittsburgh	146	180	90,680	41 720	14 805	26,499 21
12. Cheyenne-Pueblo	408	90	36,790	54 190	18,680	35,382.60
16. Cleveland-Louisville	517	90	78,094	60,830	18,465	52,845 62
17 New York-Chicago	736	255	587 256	292,014	579,907	331,067 02
18. Chicago-San Francisco	2,027	180	764 157	740 855	465 024	847,401 01
19 New York-Atlanta	805	270	466,405	415 002	152,291	323,035 36
20 Albany-Cleveland	465	77	71,802	56 224	10 612	46,425.10
21 Dallas-Galveston	555	90	90,946	55 277	9 088	34,910.52
22. Dallas-Brownsville	547	90	98,460	80 292	20 528	65,669 82
23 Atlanta-New Orleans	468	90	87,846	84 527	24,598	61 175 95
24 Chicago-Cincinnati	274	180	101 106	89 297	24,853	61 945 52
25 Atlanta-Miami	777	180	283 163	258,838	88 706	157 091 46
26 Great Falls-Salt Lake City	509	90	119 789	114 054	13 748	75,780.27
27 Bay City-Chicago	974	75	105,590	142,221	46 987	107 234.03
28. St. Louis-Omaha	608	180	145 938	151 059	59 249	90,811 19
29 New Orleans-Houston	519	90	57 420	57 541	12,757	12,736.24
30 Chicago-Atlanta	810	90	188,460	136,551	59 087	116 217 67
33. Atlanta-Los Angeles	2,375	90	433 178	524,647	90 216	554 830 00
34. New York-Los Angeles	3 335	90	802 303	461 095	51 851	187 618.47
Totals	21,887	3,590	5 620 272	5.165 559	2,054,346	$4,900 068.53

* Figures for March are based on estimates by the Post Office Department.

Aeronautical Exports

	Total Dollars	Aircraft No.	Aircraft Dollars	Engines No.	Engines Dollars	Parts and Accessories Dollars
Europe						
Belgium	5 327					5,327
Czechoslovakia	2,815					2,815
Finland	530					550
France	1,106					1,106
Germany	12,052	1	1,600	2	5,519	4,955
Italy	17 459					17,459
Latvia	118					118
Netherlands	81 871	1	5,500	11	66,649	11,727
Poland and Danzig	5 237					5,257
Soviet Russia	295 695			27	179,462	116,235
Spain	5,675	2	5,675			
Sweden	2,198					2,198
United Kingdom	106,276	3	94,518	1	793	10 985
North America						
Canada and Newfoundland	130,396	3	16,300	3	11 885	122,295
Central America						
Guatemala	5,348	1	5,000			2,348
Honduras	104					104
Panama	58,894			9	53 145	5 749
Mexico	85 846	3	45 987	3	3,300	36,790
Barbados	41					41
Jamaica	80					80
Trinidad and Tobago	1,116			1	918	198
Other British West Indies	500					300
Cuba	5 530					5,590
South America						
Argentina	81 275	2	35,926	3	17,255	28,094
Brazil	38,968			1	2,755	36,215
Chile	133 846			11	78,990	54 856
Colombia	19,551	1	18,090			1 551
Peru	25 344					25 344
Venezuela	634					634
Asia						
British India	1 236	1	975			261
China	39 128	1	12,000	3	11,887	15,461
Java and Madura	1,708					1,708
Other Dutch East Indies	51					51
Hong Kong	42,600	5	42,600			
Japan	48,210			1	9,846	98 364
Siam	790					750
Oceania						
Philippine Islands	21 155	3	18,710			2,445
Australia	29 987	1	25,094			4,987
Africa						
Union of South Africa	190					198
Egypt	230					230
Italian Africa	1,230					1,790
Total exports	$1 304,586	28	$521 591	76	$422,284	$560 911

FOREIGN TRADE
(Page 288)

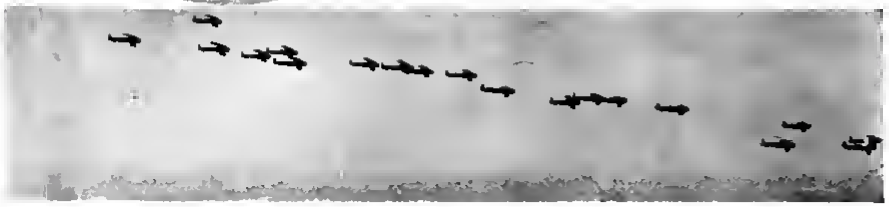
ANY comparison of 1931 figures with those of the preceding years is likely to seem discouraging Aeronautical exports for the first quarter of the year, however, do not give grouds for unadulterated pessimism The total value is about 20 per cent below the 1930 figure of $1,672,720, but in view of the fact that the sum of all exports from the United States is 37 per cent lower than for the first three months of 1930, the decline in aeronautical exports is not outstanding.

A more detailed analysis shows that although the exports of aircraft have been reduced to less than half their previous figure, aircraft engine exports have almost doubled in value There has been a slight increase in the exports of parts and accessories as well Soviet Russia, which was the largest purchaser of aeronautical products in this period, is largely responsible for the increase in engines exported, 27 engines valued at $179,462 having been shipped to that country in March Chile and the Netherlands were also large purchasers.

The extensive purchases by Canada of aircraft parts and accessories bring that country to second place on the list of markets for all aeronautical products during the first quarter, with Chile a close third and the United Kingdom in fourth place. The last-named country is the most important purchaser of aircraft during the first quarter of the year, a very unusual situation, for British commercial operations of course depend entirely upon the products of home industry The largest number of airplanes was sent to Hong Kong Argentina, Peru, China, and Mexico, conspicuous as buyers of American aircraft in 1930, have relinquished their leading positions to European countries.

Bombers over Washington

Pursuit, observation and bomber formations



More than any of their predecessors the Air Corps maneuvers of 1931 appeal to the aviation industry. There will be an unprecedented use of commercial aircraft for transport and an unprecedented degree of co-operation between commercial airports and military units. A further report of developments during the maneuvers from the technical point of view will be given in the July issue of AVIATION. The very elaborate plans of operation and supply are summarized in this article.

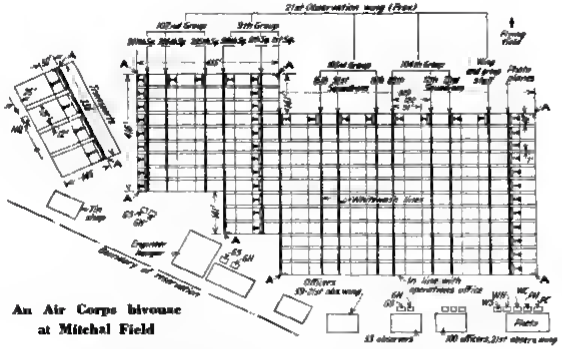
A flight of Condor bombers

Plans for the Air Corps maneuvers

THE 1931 Air Corps maneuvers are notable for bringing together the largest number of military aircraft ever assembled under a unified command in time of peace. They offer the first occasion for the creation of a divisional organization in aerial practice. They mark also an important test, the most extensive that has ever been attempted, of the possibilities of commercial air navigation facilities pressed into military service. The aircraft industry has always provided the flying equipment for the Army and Navy. During the 1931 maneuvers commercial developments will be largely responsible also for the airports and ground organization used.

A total of 667 planes, 692 officers, 69 cadets, 643 enlisted men and 14 civilian mechanics have been assembled for organization of the 1st Air Division (provisional). All types of the Army's planes are represented; 204 pursuit, 261 observation, 70 attack, 80 bombardment, 50 transport, and 2 special photo planes. All but three of the machines are of standard types. In addition to the regular military equipment a number of commercial planes have been loaned by their manufacturers or by industrial owners such as the Standard Oil Company of New Jersey, for transport purposes.

Almost a score of manufacturers of airplanes and engines are represented by their products. Curtiss-Wright Corporation is leading in variety and number of planes. Fifty-eight Hawk pursuits are powered with D-12's, 17 Hawks with Conquerors, 70 Falcon observation and attack planes with D-12's, 24 Falcon observation planes with Liberties, 9 Condor heavy bombardment planes with Conquerors, and 34 Keystones with Hornets. United Aircraft and Transport is a close second



An Air Corps bivouac at Mitchel Field

The layout above is an example of the detailed parking arrangements drawn up for each field used by the division

with its Boeing pursuits and a few Sikorsky transports, while its Pratt & Whitney engines predominate the power plants. Boeing is represented by 129 pursuits powered with Wasps, Douglas by 51 observation planes powered with Liberties, 82 with Hornets and 8 with Conquerors by 35 basic training machines powered with Wasps and one with a Liberty, and by a number of Liberty-engined transports. There are 55 Wasp-powered Thomas-Morse observation planes Ford, Fokker, Sikorsky transports and miscellaneous machines total about 50.

This air fleet is organized along the lines of a regular air division with four wings—one pursuit, two observation and one bombardment—and two independent groups, one attack and the other transport. The organization structure, from top to bottom, general headquarters staff, the wing, consisting of two to four groups; the group, consisting of two to four squadrons each. Each pursuit squadron has 18 planes, observation and attack 12, bombardment 9. A total of 32 squadrons of the regular Air Corps, not including the transport units organized for the special purpose of the maneuvers, and six from the National Guards of nineteen states, are listed to participate.

Samples of about every type and make of plane owned by the Corps are employed to transport general officers and wing staffs. Within the tactical units the equipment is of course more standardized. The 1st Pursuit Group from Selfridge Field and the 20th Pursuit Group from Mather and Rockwell Fields are flying Wasp-powered Boeings. The 101st Pursuit Group from Kelly Field have Curtiss Hawks powered with Curtiss D-12's. The Langley Field squadrons of the 2d Bombardment Group are equipped with 30 Hornet-powered Keystones and the Rockwell squadron with nine Conqueror-powered Condors. The 7th Bombardment Group, from March and Kelly Fields, use 30 Hornet-powered Douglas craft. Others are:

21st Observation Wing

9th Group, Mitchell Field, 39 Falcon (01-E), D-12

102d Group, Kelly Field, 21 Douglas (0-2H), Liberty, and 9 Falcon (0-11), Liberty

103d Group, Scott and Crissy Field, 15 Thomas-Morse (0-19), Wasp and 12 Douglas Basic Trainers (BT-2B), Wasp

104th Group, Dodd, Maxwell, Post and Kelly Fields, 39 Thomas-Morse (0-19), Wasp.

52nd Observation Wing

151st Group, National Guard squadrons from Washington, Minnesota, Illinois, California, Texas, Ohio, Connecticut, New York, Tennessee and Maryland, 59 Douglas (0-2H), Hornet.

152nd Group, National Guard units from Colorado, Indiana, Missouri, Massachusetts, Alabama, Arkansas, New Jersey, Michigan, and Pennsylvania, 39 Douglas (0-2H), Liberty, and 15 Falcon (0-11), Liberty

The 3d Attack Group is equipped throughout with Falcons powered with D-12's. The Transport Group com-

The new Fokker ambulance plane and (at the bottom) a Hornet-powered Keystone light bomber

poses transport equipment from all over the country.

Not the least of the myriad of details involved were the unspectacular but extremely important advance preparations and rehearsals. The entire operation was separated into four phases—Phase A, which involved all training of personnel and tuning up of equipment preliminary to the departure of the units from their home stations; Phase B, which included the passage of the unit to the point of concentration (either Wright Field or Fairfield Air Depot only a few miles away); Phase C, which covered all functioning of the units as organized into the provisional division, and Phase D, the demobilization, the return to home stations after the disbandment of the division at Washington.

As an incidental purpose of the maneuvers was to show the Army in the air to as many people as possible, the routes of the planes in Phase B were carefully laid out to bring them in straight formation flights over many communities en route. Thus, all over the country abridged editions of what was later to be seen by the larger metropolitan areas of the Northeastern states were displayed as generously as conditions allowed.

Phase C is, of course, the climax to the whole effort. The maneuvers therein are arranged in five main areas, supplemented by a number of demonstrations over large cities sandwiched in between the features of the program. The areas are: Dayton-Fairfield, May 13-19; Chicago May 19-20; New York, May 21-24 and May 26-29; New England, May 24-26 and Washington, May 29-31. During this phase Maj. Gen. B. D. Foulois, assistant chief of the Air Corps and the oldest military pilot in the world in terms of continuous service (he learned to fly from Orville Wright in 1909), is in direct command.

Housing and parking

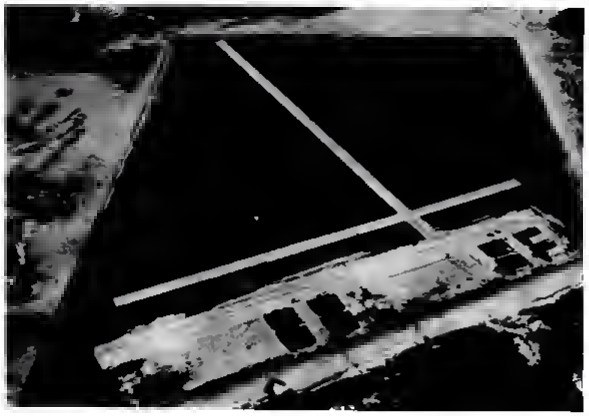
Housing of personnel and arrangements for parking equipment in the various areas is the largest problem of that sort that the Air Corps had ever been called upon to tackle. With the exception of the Dayton-Fairfield area it is necessary at every stop of the division to depend upon civil airports for space. Not even a military field with personnel under military discipline and trained for the handling of aircraft coming in organized units could take care of 667 airplanes. For a single commercial field with no permanent military personnel and no military indoctrination to attempt anything of the sort would be to court chaos and to invite disaster. Hence, the operations plan includes an elaborate scheme of division of the units among the fields of each area, with equally elaborate and detailed communication schedules to insure a perfect coordination of the work of planes based on the several different fields, and at the same time avoid undue disturbance of normal commercial traffic. Five fields are being used in the New York area, five around Chicago, and the same number around Washington although in that case they are scattered over an area extending about 200 mi. from Wilmington, Delaware, to Langley Field, Va. The facilities of several oil companies are used to the utmost to provide for storing the necessary amount of fuel and supplying it with the necessary rapidity. The record for a single field is being made at the Bowles Airport at Springfield, Mass., where 420 airplanes, nearly two-thirds of the total force, base for a day. The accompanying plan of part of the parking area at Mitchel Field indicates the detailed arrangements involved in preparing the available areas. Maneuvering into and out of allotted parking space constitutes quite as keen a test of the efficiency of the organization and of the pilots and mechanics as do the squadron operations in the air.

The Thomas-Morse observation type

A Boeing pursuit (at right) and a Curtiss Falcon (below)

Annual maneuvers

One of the earliest of these Air Corps maneuvers was the spectacular bombing exercises off the Virginia Capes in 1923. In the last few years they have become, like the great joint battle exercises of the United States fleet and like the maneuvers or sham battles of the R.A.F. in the London area, an annual feature. The maneuvers in 1929 consisted of a "war" between Blue and Red forces in the Dayton-Columbus, Ohio, region. Last year more planes were employed and the competitive features were largely eliminated in favor of demonstrations of mass operations on various missions and under various operating conditions, with a focal point in central California. This year the exercises take the same form, but with still more planes available. They again depart from the usual rule of maneuvers, whether naval, military, or aerial, in laying stress upon operation of the entire available force as a combined unit rather than upon mock battles following a period of strategic maneuvers by two forces. For the first time the National Guard units, organized as an observation wing, are participating as a tactical unit.



Floyd Bennett Field during the construction of the hangar units and before the erection of the administration building which now occupies the area between the two groups of hangars. The highway in the foreground is Flatbush Avenue, Brooklyn. Note wide apron in front of the line of buildings.

New York City dedicates its airport

Floyd Bennett Field, New York City's Municipal airport, opened for service during the maneuvers of the Army Air Corps on May 23

THE largest city in the country now has its municipal airport. Floyd Bennett Field, named after Rear Admiral Byrd's former pilot, is being dedicated and put into service May 23 as one of the main events in connection with the Army Air Corps maneuvers in the New York area. Army units are participating in the exercises with formation flights and special demonstrations.

This municipal airport is the result of a movement begun in 1927. Agitation at that time attracted the aid of federal aviation leaders who considered the selection and development of an airport for the city of more than ordinary importance. The committee of city, state, and federal representatives made a careful survey of suggested available sites in the metropolitan area and recommended certain sites, from which the Floyd Bennett tract was finally selected.

The choice was made in February of 1928. Money was appropriated in 1929 and work started. A total of about $3,100,000 has been spent to date and recently another appropriation of $666,000 became available for further refinements. The present installation includes two long concrete runways, eight hangars, a large administration building and complete lighting equipment.

The developed area in its original state consisted of about 500 acres of marsh and sandy soil, much of it under water. This tract was built up to a finished level of 16 ft. above mean low water with approximately 14,000,000 cu yd. of sand fill. A large proportion of this came from a 1,000x30-ft. channel dredged in Jamaica Bay by the city for the federal government. The latter paid the city 10c. per cu yd. for what was taken out of the channel.

A 4-in. layer of earth and clay was placed on top of this fill to hold moisture. Contrary to the usual experience of most airports, the problem was one of retaining water rather than getting rid of it. The sandy soil provides practically perfect natural drainage. The only special drainage equipment consists of sumps filled with gravel spaced about the area to care for excessive rainfall. On top of the 4-in. earth and clay layer, is a 3-in. stratum of top soil which has been rolled and seeded to provide a turf surface.

400-acre landing area

This grass area and the runways provide an effective landing area of approximately 400 acres. The grassed area is to be improved each year by the addition of several inches of top soil with similar seeding treatment in an attempt to provide a tough and resilient surface. High grade golf course grass seed mixed with special grade to give it increased toughness was used.

The runways measure 4,110x100 ft. and 3,110x100 ft. There is also a 3,200 x200-ft. concrete apron. Highway concrete, 8 in. thick and reinforced with wire mesh was used for runways; the aprons are 7 in. thick. The concrete slabs in the runways rest on a 2-in. stone and gravel base. Along the edges are gravel filled trenches several feet deep. Installation of these runways, the aprons, the filling and grading operations, and seeding, cost approximately $900,000.

Having completed the surfacing attention was turned to the erection of buildings. The administration building occupies the center of the group facing Flatbush Avenue, Brooklyn, the surface approach to the port. This building cost about $225,000, is of brick and steel and rests on 300 cast-in-place piles. About 260 tons of steel were used in it. It has two stories and a basement with a two-story tower in the center. The usual lobby, office space and miscellaneous accommodations are provided. Sleeping quarters consist of six rooms, equipped with four beds each and lockers, and other facilities. These dormitories are for the benefit of pilots and are not operated on a hotel plan.

This building is flanked on each side by four hangars in double rows, the sides being parallel to the field. Each hangar cost a little more than $100,000. They are of brick and steel construction and each rests on 1,200 pre-cast concrete piles. Two hundred tons of steel were used in each hangar. They are uniform in size measuring 150x 140 ft., 30 ft. high, and provide a clear door space 120x22 ft. They have the usual lean-to for office and shop space. A feature is the use of aluminum doors, said to weigh almost a third of conventional doors of the same size and manually operated.

Lighting equipment cost approximately $100,000. There are two floodlights—Sperry-A.G.A. 1,000 mm., with 180-deg. dioptric lens—one on the northwest side of the field and the other on the southeast, providing a minimum of 0.25 candle intensity all over the field. Each light is housed in a small building. The lights are about 16 ft. above the ground and are operated remotely from the main switchboard in the control tower or within the building itself.

Boundary, obstruction, airport beacon, code beacon, ceiling and traffic signal lights, were supplied by the General Electric Company. About 600 lamps are included in the boundary system which is served by 6 mi. of trench cable. The airport name is emblazoned in red Neon lights, the letters being 6 ft. high. The marker circle in the center of the landing area is illuminated by lights placed flush with the ground. All lighting is centered in a table-top type switchboard in the control tower. Brooklyn Edison current is used.

Room for expansion

There is plenty of room for expansion to meet future needs. The entire tract includes about 1,000 acres, the undeveloped part being tentatively assigned to future improvements for lighter-than-air operations. A seaplane base is to be installed soon. The port area borders on Jamaica Bay and on that border will be installed a number of hangars and a creosoted timber ramp, measuring 283x100 ft., with the water end 4 ft. below the surface at low water. There is ample landing area for seaplanes and amphibions in the area contiguous to this boundary.

The original estimate for the development of this port was placed at $5,500,000. Because of keen competition over contracts however, it is expected that the completed port will cost less than $4,000,000. The first appropriation, made in 1929, was for $2,500,000. This was a straight budget appropriation. In 1930, $588,000 was made available and the above mentioned $666,000 has just been approved. These were both provided through tax notes to be refunded out of the next year's budget.

The city will consider this plant a public necessity after the fashion of municipal docks, highways, and parks, eliminating the burden of making it pay for itself. Other operating policies have not been determined as yet.

The tract lies 11 mi. southeast from City Hall in Manhattan and about 14 mi. from the General Post Office. It may be reached in a little over an hour by subway and surface transportation along Flatbush Avenue in Brooklyn.

One of the $100,000 hangars at Floyd Bennett Field. At bottom: Looking across the concrete apron at the hangar units

An unresolved tactical problem which is now attracting attention in the British R. A. F.

Single or twin-engined day bombers?

By
Major Oliver Stewart
M.C., A.F.C.

AIR FORCE commands in all countries are constantly trying to maintain a fair balance between the military and the aerodynamical qualities of service aircraft. They are constantly trying to estimate accurately how much speed and climb they can sacrifice to load of bombs, guns, ammunition, full equipment and wide fields of view and of fire. The perfect military aircraft is the one in which this balance has been correctly struck.

In day bombing aircraft the fixing of the right proportions of military and aerodynamical requirements is more difficult than in any other type, and it is at the present moment attracting a great deal of attention. There is divergence of opinion on a large number of points, but on none is it more marked than on the number of engines required. To-day both the twin and the single-engined day bomber are undergoing close scrutiny, with a view to determining if either shows a definite superiority. The Royal Air Force has been particularly interested in the problem, and has given it particularly close analysis.

The major requirements in the day bomber are: Long range and big load; steadiness of bombing platform; good powers of defence.

The first need not detain us long. Long range and big load are essentially aerodynamical qualities and, on a basis of equal power, it would seem that the single-engined machine has the superiority. All the aircraft which have been used recently for the obtaining of world's distance records, both in closed circuit and in a straight line, have been single-engined. The Bernard monoplane of Antoine Paillard and Jean Mermoz, the Blériot of Bossoutrot and Rossi, and the long range monoplane now being built for the Royal Air Force for another attempt to fly non-stop from London to Capetown are all single-engined aircraft.

Steadiness of bombing platform, judging from the results of bombing exercises with live bombs, is better secured in the twin-engined machine. The twin also has the advantage in that its bomb aimer can be housed in a forward cockpit from which he has a clear view for aiming, and can better direct his pilot than if he be placed in a cockpit in the rear. A twin-engined day bombing squadron of the R.A.F. was the first to obtain an average error of less than 100 yd. [This record is believed to have been made from bombing altitude of 6,000 ft.—Ed.] during the annual exercises of that service. Moreover this squadron has lately attained an accuracy almost equal to that of the night bombing squadrons with their much larger twin-engined aircraft, and has shown a marked superiority in accuracy over all the squadrons equipped with single-engined planes. As a platform for the launching of bombs it appears that the twin is the better. The probable reasons are that it has no engine directly mounted to the fuselage structure, and consequently no engine tremor in the bomber's cockpit, and that it is a larger aircraft than its single-engined counterpart.

The relative powers of defence of the two types offer the most important and most complex point of all. Aircraft, the air strategists are never tired of telling us, are instruments of attack. Defence in the air, therefore, implies that the aircraft has special work such as reconnaissance, bombing, or photography to do, and that, having done it, it must return home. It cannot waste time in turning and engaging hostile aircraft more than is absolutely necessary for its own protection. In this sense the aircraft can defend itself by two methods; by performance and by gunfire. They are derivatives from the same two general qualities, aerodynamical and military, which were mentioned at the beginning of this article as being held in balance in all military aircraft.

Defence by performance consists mainly in running away. The day bombing squadron, seen when far over enemy territory by hostile pursuit planes, has no other duty than that of completing its raid and getting home. It must run away if it can. If it stops to fight it is failing to fulfil to the most efficient way the function for which it was put in the air. It must therefore possess very high top speed so that it may be able to outdistance the fighters if it is given a short start. If it sees fighters climbing up from an enemy field it must be able to reach its objective, launch its bombs and be well on the way back before the fighters have climbed to a sufficient height to attack it with any prospect of success.

Up to the present the single-engined aircraft has always been superior in speed to the comparable twin-engined type. Carrying a load of about 500 lb. of bombs and full equipment in the way of guns and ammunition, the modern single-engined day bomber should be capable of a speed of between 185 and 190 m.p.h. at 10,000 ft. [It will be remembered that this is a British view, expressing British experience.—Ed.] So far the best twin-engined day bomber, carrying say twice the load in the same conditions and at the same height, has fallen short of this by 30 m.p.h. and more; but it is to be noted that less attention has been paid to their aerodynamic development in the recent past than to that of the single-engined type. Now, with attention once more directed toward twin-engined planes, it is likely that the difference in speed will be reduced in the near future to perhaps 20 m.p.h. or slightly less. Even so the single-engined day bomber seems likely to remain the faster by a considerable margin, and therefore the better able to evade attack.

The powers of manœuver of the single-engined machines are again better than those of the twin. If therefore the day bomber is forced to fight, the single-engined machine will more readily attain superiority of position. But the day bomber is not meant to fight, and

Although AVIATION makes no attempt to play the part of a professional journal of the military art, nor to print disquisitions upon the minutiae of aerial warfare, the trend of military design is necessarily a great factor in the plans of the industry. It is a special pleasure to present to our readers, both in the Army and Navy and in the industry, an analysis of a particular problem of design by a distinguished British expert. Major Stewart, formerly of the Royal Air Force, aeronautical correspondent of the London *Morning Post* and AVIATION'S British correspondent, is a well-known student of the theory and practice of aerial war. His book on "The Strategy and Tactics of Air Fighting" is a classic of the subject.

The United States Navy uses bombers of both types. Above: A Douglas design. Below: A Martin product

if it is unable to avoid attack or to reply to it while still maintaining course, it fails in its purpose.

The twin-engined day bomber cannot *evade* attack so easily as the single-engined machine because it is slower, but what is almost equally good, it can reply to attack while maintaining course or only altering course to a small extent. It replies by means of gunfire. The only type of twin in standard use as a day bomber in the Royal Air Force at the moment has three gunners' positions. The first is in the extreme nose, where more than a hemisphere of the sky is covered by the gun; the second is behind the wings, where the upper hemisphere is covered and certain sectors at the sides of the machine in a downwards direction, and the third is in a gun tunnel facing backwards and downwards underneath the fuselage. This last gun covers a large sector downwards and to the rear.

These three gun positions cover nearly the whole sphere of sky and permit the crew of the aircraft to reply to attack coming from any direction *without the aircraft itself being forced to alter course*. It can maintain its compass course for its objective or for its home aerodrome while at the same time returning fire in any direction from which attacks may come. But how effective is this return fire as compared with the fire from the fixed, line-of-flight guns of the fighters?

Recent experiments on that point again favor the twin-engined machine. Tests with camera guns indicate that the shooting of the gunners of the twin is more accurate than that of the pilots of the single-seater fighters. But these results must be accepted with caution for they are diametrically opposed to all active service experience. Active service experience says that a pilot of a single-seater fighter may, without seeking protection by approaching from a blind spot, dive on the gunners of a multi-seater aircraft with a good chance that his fire will take effect before that of his opponents. Remember that during the dive he is armored by his engine, which is in effect an impenetrable shield covering all but the top part of his head. The unfortunate gunner in the multi-seater is totally unprotected.

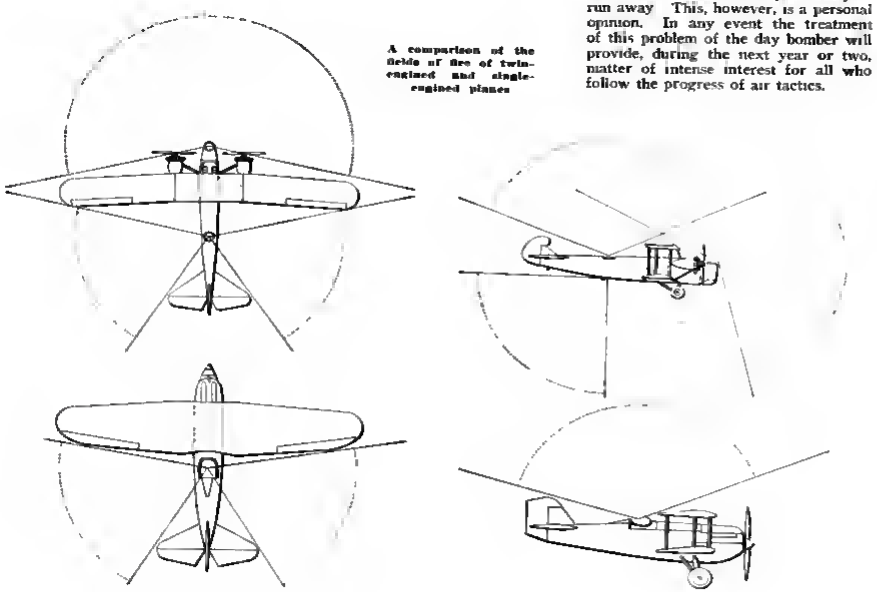
Protecting the gunners

Needless to say, attempts have been and are still being made to protect the gunners. Special shields for them have been devised, gun turrets have been tried. But all such devices reduce the performance of the multi-seater; and that performance is already below that of the single-engined machine, whether single or two-seater.

If it is assumed that the fire of the gunner in the multi-seater is as likely to take effect as the fire of the pilot of the single-seater fighter that is attacking it, then there is a complete and unanswerable case for the twin-engined day bomber and for the total abolition of the single-engined bombing machine.

The twin carries nearly as much per horsepower and has nearly the same range, as the single-engined machine. It is a better bombing platform and, owing to the wide field of view of its crew, it is less likely to be surprised. It can reply to attack without altering course. If that reply by gunfire is effective, then the need of being able to run away as fast as the single-engined machine disappears and from every point of view the twin is superior. But is the reply by gunfire effective?

That is the crucial question which the air staffs of the different countries must decide for themselves. The present writer's view is that the camera gun tests are not conclusive and that, in actual practice, the fire from movable guns cannot give adequate defence unless the gunners' positions are armored in some way yet to be devised. Therefore the day bomber should still pay more attention to aerodynamic qualities than to military qualities and should still rely for its defence upon ability to run away. This, however, is a personal opinion. In any event the treatment of this problem of the day bomber will provide, during the next year or two, matter of intense interest for all who follow the progress of air tactics.



A comparison of the fields of fire of twin-engined and single-engined planes

An engineer of the Aeronautics Bureau of the Navy Department discusses corrosion in duralumin rivets, and its pertinent relation to manufacturing methods.

Corrosion of duralumin rivets

By James E. Sullivan

Rivet corrosion on the bottom of a flying boat hull

IN the field of metal aircraft the causes of corrosion and the measures necessary to prevent it are much debated subjects, and there seems to be a widespread belief that corrosion is inevitable. Duralumin in particular, has been the target of much criticism because of its reputed susceptibility to corrosion. With the continued and increasing use of this material, however, it has been proven convincingly that it can be employed successfully in aircraft even under severe conditions, and that its poor reputation on this score is much exaggerated and undeserved. In the majority of cases the trouble is due usually to poor shop practices by the airplane manufacturer, or to the lack of proper maintenance in service.

Considerable difficulty has been experienced from corrosion of rivets on aluminum alloy flying boats and floats. This condition has been especially irksome on aircraft operating near salt water where corrosion, once started, accelerates rapidly. The Bureau of Aeronautics of the Navy Department, and several commercial transport lines operating on or near salt water, have been greatly handicapped by this problem, as it has been necessary to withdraw airplanes from service for extended periods for repair or replacement of floats. Serious trouble of this kind was reported on several new flying boats on a cruise from England to India, where it was necessary to remove large numbers of corroded rivets and replace them with screws. In one case approximately 10,000 rivets had to be removed, or about one-eighth of the total number in the hull. Whenever such cases of corrosion are investigated, the picture is generally the same. Corrosion will have occurred at several rivets, then several will be found in perfectly sound condition, followed by one or two corroded ones, and so on. At times as many as 10 to 20 per cent of the rivets are corroded. One very significant fact stands out in each case,—when corrosive attack has once started it progresses rapidly, and results in complete breakdown of the rivet. The good rivets are entirely sound. The photograph on this page is typical of this condition.

Possible sources of trouble

Many explanations have been advanced and investigated in detail. Some maintained that the shape of the rivet head was mainly responsible for the corrosion. This theory was exploded when thorough tests proved conclusively that corrosion occurred on all types of heads at almost the same rate. Others maintained that removal of the protective coatings from the rivet heads was the cause. This seemed feasible, but, although it is undoubtedly a contributing factor, it was found that corrosion would sometimes occur more quickly on painted rivet heads than on unpainted ones. Belief was also expressed that the use of improper materials in manufacture was responsible. This seemed reasonable as some aluminum alloys are more susceptible to corrosion than duralumin, and substitutions might occur between manufacture and use. This theory did not hold water, however, as a chemical analysis of numerous cor-

roded rivets indicated that the material was actually duralumin.

An unusually interesting phase of this investigation brought out the fact that aluminum alloy screws of the same chemical composition as the rivets did not corrode when properly protected, and when given routine maintenance. Occasionally a corroded screw was found in service, but, on the whole, the number was small. A number of float manufacturers began using screws instead of rivets, in spite of increased weight, more complicated shop practice, and the possibility of their loosening and causing leaks. Many manufacturers prefer using screws as they are procured ready for use without fuether heat treatment.

Heat treatment

It has long been known that duralumin rivets should be driven cold immediately following heat treatment in order to obtain maximum physical properties. It is further known that improperly heat treated rivets are deficient in corrosion resistance. As the rivets are usually obtained in the annealed condition to be heat treated by the manufacturer it seemed probable that the trouble arose from the use of improper heat treatment methods. This assumption was substantiated upon a microscopic examination of a number of corroded rivets which proved conclusively that the micro-structure in every instance was not comparable to that of properly heat treated aluminum alloy.

A thorough investigation of the heat treatment facilities and methods in use produced startling results. In most cases the actual manufacturing procedure varied widely from theoretically correct practice. One common fault was the failure to leave the rivets in the furnace long enough. It is impossible to state generally how long they should remain in a furnace as this will vary with the type of furnace, shape of the rivet container, and volume of rivets treated, but the manufacturer can readily establish the proper time limits for his particular needs by conducting surveys with a sensitive thermo-couple embedded in the center of the mass of rivets. Accurate temperature control is of paramount importance, and can be best obtained through the use of available automatic temperature controlling, and recoeding devices. These devices are of material assistance in determining when the proper temperature is reached, and in keeping the rivets at this temperature to insure complete saturation.

Quenching

Another feature which seemed to be very much misunderstood was the procedure for quenching rivets. After heating to the prescribed temperature (usually 950 deg. F.) and holding at this temperature for the required time, rivets should be plunged into *cold* water with the *minimum delay*. A sufficient volume of water should be used so that the heat in the load will not raise the temperature of the quenching water above 150 deg. F. There should be no intermediate slow cooling in air or steam as rapidity of quenching is a very important factor toward retarding corrosion by embrittlement. The time of transfer from furnace to quenching bath should be held to a few seconds. If the rivets have been heated in a nitrate bath they must be thoroughly washed after quenching to remove all traces of adhering salt. This may be accomplished more readily if the temperature of the wash water is around 150 deg. F.

Certain manufacturers heat treat rivets by placing them in an iron pipe perforated to admit the heating and quenching media. A tin can with a few holes punched in it sometimes serves. Upon dipping such a container into water, many of the rivets, especially those in the center of the mass, are quenched in steam rather than in water. This is poor practice as rivets so quenched have shown decidedly inferior corrosion resistance. It should be borne in mind thet the principal thing to accomplish is to extract the heat quickly from each and every rivet. This can be done in many ways, but the method which has been found most satisfactory consists simply in upsetting the container and pouring the rivets into the water.

Under normal working conditions, rivets should be driven within 30 min. after heat treating. For best results in aircraft construction, rivets not driven within this period must be returned for re-heat treating, for as time elapses, the rivets become harder and more difficult to head up. It has been recently discovered, however, thet it is possible to obviate close coordination between quenching and pointing by placing the quenched rivets in a container maintained at a temperature of 32 deg. F. or lower, and withdrawing them as required. The cold storage compartment may be simply a receptacle holding ice water, or it may be an electric refrigerator. If aluminum alloy rivets are quenched and kept at this low temperature, aging will be retarded for at least twenty-four hours. Upon removing the rivets from the refrigerator they will warm up to room temperature, and aging will proceed as though they had just been removed from the furnace. Such rivets as are removed from the refrigerator and held at room temperature for one-half hour or more and not used should be re-heat treated. Although this practice does not fully overcome all difficulties connected with the heat treatment and use of aluminum alloy rivets, it does provide a storage place for 24 hr., and permits the shop to heat treat a large quantity of rivets at one time.

An efficient three compartment rivet basket

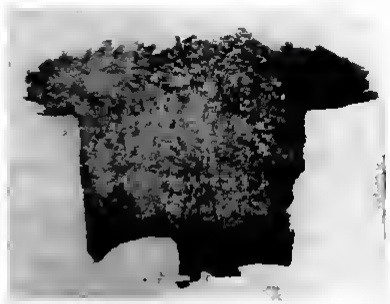
Example of good practice

In one plant samples are taken from each lot of dural rivets received from stores, given the heat treatment required for fabrication, and then submitted to a double shear and hardness test to insure their conformity to the material specification concerned. Rockwell hardness readings, using a 60 kg load, taken five minutes after heat treatment should be between B41 and B52. This test, in addition to being essentially a material inspection test, is indirectly a test upon the method of heat treatment, as the rivets are heat treated in the same bath as those being heat treated for fabrication in airplane parts.

The type of furnace used in this case is an automatically controlled A-C electric salt bath with automatic recording instruments attached. Eight thermo-couple leads to various points of the furnace are provided. All rivets are held in the furnace for a period of twenty minutes at a temperature of 950 deg. F., then removed and quenched in cold water. A three section demountable rivet basket with separate containers is used. The latter are 2 in in diameter and 6 in. high, and are well spaced to permit uniform heating and complete quenching of the charge in each. Newly heat treated rivets are distributed to workmen every 30 min. and no rivets are permitted to remain with the worker for longer than this period. In general, workmen prefer to drive freshly heat treated rivets because the material is softer and is worked more readily, but, since the material is still quite malleable at the end of half an hour, there is danger of such rivets being driven without the workmen realizing it. Periodic checks are made at the benches to insure that rivets are being removed as required. A small stock of the most commonly used sizes of rivets is kept near the heat treating furnace. A new batch is heat treated every half hour, and the stock remaining from the previous heat is set aside for re-heat treatment.

Protective coats

It must not be assumed from the foregoing that proper heat treatment, important as it is, can be considered the cure-all for aluminum alloy rivet corrosion. Additional precautions in applying suitable protective coatings which adhere satisfactorily are necessary; periodic inspection is excellent insurance against deterioration. A number of float manufacturers have found that painting the areas around rivet holes just prior to the insertion of anodically treated rivets has produced good results. The anodic film not only retards corrosion but provides a base to which other protective coatings adhere tenaciously. A further refinement of some value consists in the use of long radius, or countersunk heads, in places subject to abrasion to prevent, or at least delay, removal of the protective coatings.



Rather severe corrosion on the surface of a rivet head

A test for deterioration

Should rivet corrosion occur in service, it is desirable to ascertain the condition of surrounding rivets before they also begin to corrode. A comparatively simple way of determining the condition of a rivet in an assembly has recently been developed which shows promise of being valuable to maintenance units. The existing finish on the rivet must be removed, and a flat spot about ¼ in in diameter filed, or ground on the head. Apply a small drop of a solution of caustic soda (sodium hydroxide) to this spot by means of a small glass rod. The drop should be allowed to remain undisturbed for about ten minutes. Annealed or incorrectly heat treated rivets will turn the solution a black, or very dark gray color, but for correctly heat treated rivets the solution will remain approximately white, or only slightly gray.

After sufficient time has been allowed to identify the incorrectly heat treated rivets, the caustic soda should be removed by the suction of an eye dropper. A drop of 50 per cent solution of nitric acid is then applied to the head of the rivet, and allowed to remain for a period of three to five minutes, after which it should be removed by wiping with a clean wet cloth. In order to remove the last trace of acid the rivets and adjacent sheet should be cleaned again by wiping with a wet cloth.

Microstructure of the rivet shown at top, characteristic of annealed material, it was possibly used "As Received."

An area corresponding to that shown above. The structure is that produced by proper heat treatment followed by severe cold working

The non-professional market

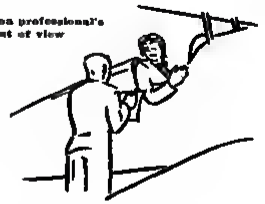
Two of the proffered solutions to the problem of producing a satisfactory plane at a price within the reach of a wider circle of prospective private owners. The Curtiss-Wright Junior (above) and the Stahl Flying Bull Pup (below) are priced at less than $1,500 and are the "very light" type.

This machine—the De Havilland Moth—represents the world's most widely adopted type for pleasure use. It is a compromise between the weight and price of the Fleet and the Curtiss-Wright cruiser class.

The Fleet is an example of the plane adapted from a military product. It is popular with those who can afford something in the $3,500 to $4,500 class.

A successful plant for the enjoyment of non-professional flying as a group activity. The Hicksville (L. I.) airport of the Aviation Country Club of Long Island

Get the non professional's point of view



The light plane enthusiasm of the current spring has created a new wave of interest in the possibilities of the private owner as an outlet for airplanes. Periodically in the past, the industry has become excited about the development of private ownership on a grand scale, but most of the efforts so far made have been abortive. The editors of AVIATION maintain an unswerving belief in the great potentialities of the private market, but there are problems to be solved and dangers to be borne in mind lest the opportunity be muffed and lest there be a repetition of the primary-glider debacle of last year or other disagreeable episodes of the past.

ONE of the industry's greatest contemporary opportunities lies in the proper exploitation of the non-professional market. Manufactures, designers, and operators have done exceedingly well by the Army, Navy, and commercial aviation. Without neglecting the possibilities already developed, the time has now come to lay greatest stress upon the layman's needs and desires in the field of flight.

The private market has been a potentiality ever since the earliest days, and non-professional flying has been done by increasing numbers of individuals. Until very recently, however, it has been forced to depend upon commercially-conceived aircraft, only indirectly adapted to the private owner's needs. It has been aviation's Cinderella.

This market is an extremely bright prospect today. We do not mean that the plane for every man has arrived. We *do* mean that thousands should be flying for pleasure, rather than hundreds. Already more than a dozen nationally known manufacturers have turned out models built specifically for the private owner. One of the leading aviation insurance groups and a leading aviation finance corporation now frankly prefer the non-professional business above all others.

Now, in the time of mounting interest, is the moment for soberest judgment. Gold-rush tendencies which have characterized previous booms and the supposed discovery of new markets produce a lot of fun for the moment, but much grief when the excitement dies. There are certain facts which must be recognized and accepted by every branch of the industry in order to achieve sound results and to avoid a repetition of the sad disillusionments which have dogged some of our past gestures. The aviation industry *must*:

1 *Get the non-professionals' point of view.* No substantial progress may be expected this year or ever, without a fundamental revision of the industry's prevailing attitude. A few years ago aviation sought with great fervor to make the average person "airminded." It is even more pertinent that right now the industry itself, particularly those manufacturers or designers who hope to make any impression on the private field, become thoroughly saturated with the ideas and the problems of the amateur pilot.

2 Consider this market something to stand or fall by, and not a mere pin-money medium. Recognize it as an end in itself, as a field to be cultivated for its own sake, as an activity having its own problems, possibilities, privileges and characteristics.

3. Take private flying's peculiar requirements as seriously as in the past the requirements of the Army, Navy, and commercial department of civil aviation have been taken; cater to it as enthusiastically, as conscientiously, and with as many sacrifices, if necessary.

4 Follow the experience of every other industry and adapt itself to an available market, rather than continue attempts to bend the market to its own ideas.

5 Eliminate once and for all the wide-spread assumption that private flying is but a step in air training, that only those intending to become professionals merit serious consideration, and that a transport license is the only one really worth having.

6. Reconsider existing engineering practices. Revise them to permit produc-

tion of conventional types better suited to the novice pilot than those now existing, or create a distinctly new line. (The latter already is represented by the very light machine and the autogiro.) At the same time the industry must avoid as a deadly plague the hasty launching of designs or manufacturing projects which might precipitate a repetition of last year's unhappy experience with the primary glider.

7. Revise sales and financing methods, and federal and state regulations to meet better the non-professional pilots' requirements.

8. *First, last and always, get the non-professional's* (the market's) *point of view*, the cardinal principle of any merchandising scheme.

The degree of success to be achieved varies directly with the degree to which these principles are followed.

Many concerns and individuals doubt the existance of a real non-professional market. How do they know it doesn't exist? It has never been seriously, adequately, fairly, cultivated. There has been no determined and persistent effort in that direction. The industry has made feeble sallies from time to time, met rebuffs and backed away, convinced

One of the salient faults has been the habit of waiting for the prospect to approach the dealer

that the private market was a mirage.

There must be thousands of prospective purchasers who would be in the air but for certain prevailing obstacles which the industry ought to have it within its own power to remove. No activity crammed with so many unique recreational attributes should be devoted exclusively to commercial and military ends.

There has been a tendency to regard any marked increase in the volume of non-professional flying impossible until such time as a radically new type of airplane has been produced. The view is probably sound for flying for the million, but there is no reason why it should apply to the thousands. Non-professional flying carried out only under favorable conditions and in the

It has long been common practice for commercial pilots to treat private activities with disdain

hands of a decently responsible person is on the average at least as safe as professional flying. Nor need the private individual necessarily be a 1,000-hr., or even a 100-hr. man. The excellent safety records of the holders of private licenses, taken as a whole, afford the proof.

Flying for pleasure is, after all, *flying for pleasure*. Flying under conditions not conducive to pleasure is not the sort of activity the non-professional seeks. The favorable conditions under which the average non-professional operates, and his temperament and sense of responsibility for a plane that is his own property off-set the hazard that might result from his limited experience and skill.

These considerations bring us to another poser—high insurance rates. Discounting the prevailing idea that the professional pilot is the only legitimate pilot, one of the leading insurance groups specializing in aviation risks now provides the non-professional with all but life coverage at rates equal to those granted the professional. In some instances, they are even less.

First cost never is the whole story. This is particularly true in flying. Operating and upkeep charges are high enough to eliminate many a good prospect after he is reconciled to the purchase price. Further refinements of engines specifically for pleasure craft, and for the service of owners who are accustomed to the ruggedness of the modern automobile are desirable. The prevailing high hangar rental rate is an exceedingly discouraging factor.

Easier financing facilities have been a great boon to all kinds of retailing in the last two decades. The general principles of financing have been applied to aviation, but only in a limited way.

At least one leading aviation credit organization, like the insurance company cited, now prefers private owner business. The private owner usually completes his payments, because he would not undertake the contract in the first place unless there was every reason to believe he could. This is by way of contrast with the operator who secures a plane on time and expects to aero the payments by commercial operations, often failing. The private owner also has more pride in his possession as a rule, and takes better care of its appearance, promising a better conditioned machine in case of repossession.

Financing charges will not decrease until insurance rates do. Of course the financing companies insist on crash coverage, the most expensive in the aviation insurance category. The insurance problem again constitutes the neck of the bottle.

Though the very light type of plane is attracting much attention, it should not be considered the entire answer to the private owner's prayer. Though designed specifically for him, and though much in the limelight at present, it is not private flying's only vehicle.

Development of the private market must include a revision of aircraft sales methods. One of the salient faults heretofore has been the habit of waiting for the prospect to approach the dealer at a field rather than seeking him out in his own haunts. The business market has been energetically explored, and the managers of business enterprises that might use an airplane have been sought out by mail and by personal solicitation. The private prospect has all too often passed unchallenged by manufacturer and salesman.

Second only to expense as an obstacle is the intense military and commercial complex. Commercial and civil aviation have been to all intent and purposes synonymous, instead of the former being but one division of the latter. Moreover, it has long been common practice for commercial pilots to treat private activities with obvious disdain,—the contempt of the professional for the amateur. Small wonder the non-commercial division has been stunted.

The Department of Commerce is set up with the commercial aspects primarily in view. The holder of a private license may not care to go into commercial work but if he would have a higher grade license to indicate his progression into a more skilled category it must be a license absolutely identified with commercial operations. This lack of recognition, coupled with the superiority complex often displayed by professional pilots meeting the non-professional, has had a subtle influence. The mere establishment of a special set of licenses for the non-professional with such grades as Private, Advance, Expert,—representing demonstrated ability in handling small and medium-sized planes, rather than experience on transport types and knowledge of meteorology and navigation, would be of immense help in distinguishing between the two types of civil flying and in giving the amateur a group consciousness and something entirely his own to be proud of.

Colonial Hangar, Newark, N. J., equipped with dome reflectors and 500-watt Mazda lamps

Hangar lighting and safety

By R. W. Cost

An engineer of the Westinghouse Lamp Company discusses the relation of adequate lighting in repair shops to safety in flight, and offers a number of pertinent suggestions in the selection and care of shop lighting equipment

SAFETY in aviation depends largely upon the mechanical fitness of the equipment used, which, in turn is predicated on regular inspection and repair. In many instances work of this nature is carried on at night in artificially lighted hangars, where to insure thoroughness and accuracy, good lighting is an absolute necessity.

The customary hangar lighting system consists of standard dome reflectors with 300 or 500-watt Mazda white bowl lamps located on 15 to 20-ft. centers close to the underside of the roof trusses, 18 to 20 ft. above the floor. Sometimes they are suspended from the roof, but are seldom located below the trusses as they then reduce the head room in the hangar. Where open reflectors are used, it is best to use white bowl Mazda lamps as they provide a well diffused illumination that minimizes sharp shadows.

The importance of well diffused illumination throughout the entire hangar cannot be stressed too strongly. If lighting units are not symmetrically spaced, or if the same size lamps are not used in each unit, the illumination will be "spotty." The contrast between light and dark areas causes eye strain and fatigue, and may result in costly errors. Inside frosted, or white bowl lamps relieve this condition materially, but greater improvement is possible by the use of special diffusers. One such lighting unit consists of an opal glass enclosing globe held in a white enameled steel reflector. A small opening in top of the reflector allows just enough light to escape to the ceiling so that it is partially lighted, thereby reducing contrast with the well lighted area below. The application of these units is similar to that for the open bowl type.

Recommended intensities

A general lighting installation with 300 or 500-watt units properly placed produces 4 to 8 foot-candles of illumination on the floor. This intensity is considered adequate for ordinary storage purposes, but is only half the value necessary for repair work. Except at a few of the larger transport terminals, much of the repair work is carried on

in hangars designed primarily for storage, and under such conditions, the need for supplementary illumination is self-evident.

Where considerable regular repair work is to be done, a permanent system for lighting areas below the wings and fuselage is highly desirable. Standard angle or elliptical reflectors with 300-watt lamps located on the side walls 10 to 15 ft above the floor on 20-ft centers will increase the average lighting intensity on the floor to about 12 foot-candles. This value approximates modern standards for the type of work involved. For operating economy these units should be controlled separately from the ceiling fixtures.

Local illumination

Since the wings and fuselage of planes intercept an appreciable amount of light from overhead fixtures, the logical method of supplying supplementary illumination near the floor, is to provide light sources at or below wing levels. Recourse may be had to the familiar extension cord and "trouble light," although this unit cannot be expected to provide general illumination. It is a good plan, however, to provide at least two convenience outlets in each wall of the hangar. To reduce fire hazard from arcing at the plug, it is advisable to use outlets which must be electrically disconnected in an arc-proof box before the plug can be removed. The cord should be of water proof rubber cable, equipped with molded rubber, or unbreakable plugs and non-metallic, keyless socket. The rough service Mazda lamp is recommended for these units.

In hangars where only a part of the floor space is set aside for repair purposes, provision for underwing illumination may be restricted to that area. If situated close to a wall several 300-watt standard angle reflectors with white bowl lamps should be mounted about 10 ft. above the floor on 10-ft. centers. When the repair section lies in an area which cannot be adequately lighted from a side wall, adjustable portable lighting fixtures are now available which offer a practical solution. The lamp arm of such fixtures may be readily adjusted for the best lighting effect and will stay in position without attention to joints or fastenings. A plug outlet on the fixture provides a convenient point for the attachment of electric tools, or extension light. It may be desirable under certain circumstances to use two or more portable fixtures directing their light on the work from different angles to avoid shadows.

Dope rooms should be lighted to an intensity from 8 to 10 foot-candles with lighting equipment designed to minimize fire hazard. Vapor-proof units having a clear glass globe enclosing the lamp greatly reduce the possibility of ignition of inflammable vapors should a lamp bulb be accidentally broken. With a ceiling not over 12 to 15 ft. high, 200-watt domes with vapor proof globes are recommended. The spacing should not exceed the mounting height. When mounted 16 to 18 ft. above the floor, 300-watt units will be required to obtain the recommended intensity.

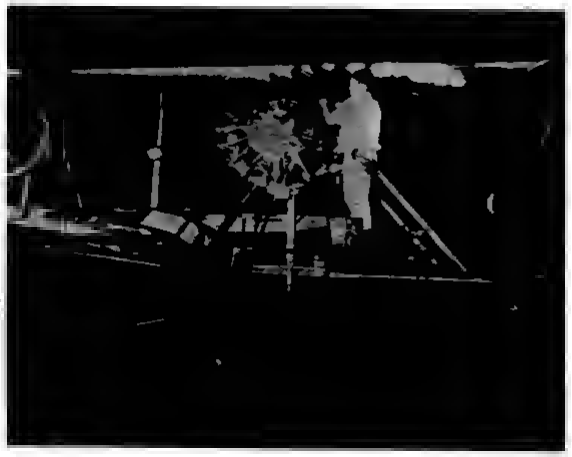
Wall coloring

The color of the ceiling, walls and floor is particularly important in the general illumination scheme. If light colors are used the average intensity will be approximately 30 per cent more than for a dark background. Concrete floors should be covered with several coats of light colored, oil-proof paint to increase reflection of light to the under-surfaces of planes.

A newly installed lighting system usually provides the illumination for which it is designed. Dust and oily exhaust vapors soon collect and adhere to the reflectors and lamps, however, reducing their original efficiency. To maintain the designed illumination, all lighting units should be wiped with a clean dry cloth at least once every two weeks, and should be washed with a soapy solution once every month. Burned out lamps should be replaced at once as one bad lamp will produce a noticeable reduction in the general illumination.

Artificial vs. natural

Admitting that good interior illumination of airplane hangars is essential at night, some engineers believe that artificial illumination is a useless expense during the day. They recommend that walls and roof be constructed almost entirely of glass assuming that since daylight is free, a direct saving can be effected. They should realize, however, that daylight varies considerably in intensity, direction, and color, depending on the sun's position. Outdoor intensity averages several thousand foot-candles on a bright day, drops to several hundred on a cloudy day, and may be reduced to less than 20 foot-candles inside the window of an industrial building. In the center of a building, the free illumination may drop to several foot-candles on cloudy days even with glass skylight facilities. Taking construction costs into consideration, it has been suggested by certain contractors that it might be more economical to construct hangar walls with few windows and increase the intensity of the electric lighting system. Some artificial lighting is essential and very little additional expense would be required to make the lighting entirely independent of daylight. Direction, distribution, intensity and color would then be under complete control. It is not impossible that the construction cost saved by using reduced window areas would cover the interest on the original investment for additional lights, and the cost of the additional power load for the life of the building.



A 12-in., 250-watt floodlight projector and portable lighting unit provide local lighting for engine repair

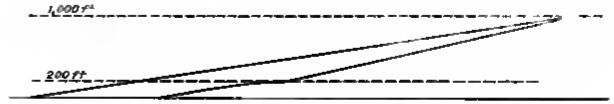


Fig. 1—Path of glide started at 1,000 ft. with angle changed at 200 ft.

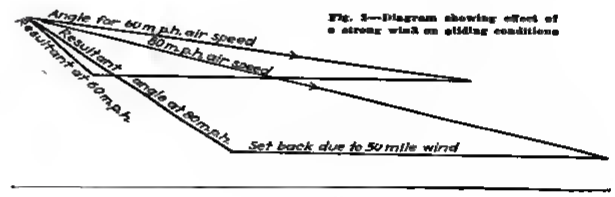


Fig. 2—Diagram showing effect of a strong wind on gliding conditions

Observations on gliding angles

By Alexander Forbes, M.D

A private owner can hardly hope to rival the research work of the National Advisory Committee for Aeronautics, but he can find a great deal of interest and profit in such experiments as do lie within his reach. Some of them require no special instruments except a stop watch. Dr. Forbes, of the Harvard Medical School, who was a scientist before he was a pilot, and who now flies his own plane for pleasure, suggests the type of research that may be undertaken by the individual pilot-owner and the sort of results that may be obtained.

STUDENTS in aviation are commonly taught that the point of starting the glide into the landing field determines the point of setting down, and that one cannot by gliding more steeply bring the point of setting down any nearer, because the resulting excess speed will cause the plane to skim over the ground to the same point which would have been reached by the normal glide. This teaching is eminently desirable, for it is quite evident that if the student pilot, after he has started his glide and comes down to an altitude of 200 ft., finds he is going to overshoot, he will not help himself by diving for the near edge of the field, and the sooner he learns that important fact, the better.

But, once the student has grasped that important maxim, it is perhaps just as well for him to learn that the law is only approximately true. It may indeed be useful for him to know in a general way how close an approximation to the truth it is, the conditions under which its inaccuracy increases, and the extent to which it diverges from the truth under conditions that are subject to actual measurement.

With a given plane, for every angle of glide there is a speed at which the forward component of gravity is just balanced by drag, and equilibrium will result, so that neither acceleration nor deceleration occurs, and the speed will be constant. When the angle of the glide is abruptly changed, there will be a definite time required to establish the new equilibrium speed. From this it should be evident that if the glide is started high enough, a measurable difference in the setting down point can be caused by varying the initial steepness of the glide.

In an effort to determine how far a steep glide may alter the place of setting down, I have tried two kinds of experiment. The first consisted in observing the time required to lose 20 m.p.h. of excess speed after changing abruptly from a steep glide to a normal glide. The test was made once in a Fledgling and three or four times in a Kitty Hawk. Once in the Kitty Hawk the speed chosen as a normal glide was 65 m.p.h.; in the other tests it was 60 m.p.h. The procedure was as follows: first, an observation was made of the position of the horizon over the nose of the plane at which a constant speed of 60 m.p.h. with the engine throttled, was steadily maintained; then the angle of glide was increased until a speed of 80 m.p.h. was attained, then the nose was quickly raised to the previous level, and the time required to bring the air speed back to 60 m.p.h. was noted. The greater part of the excess speed is lost rapidly, and the final return to the equilibrium velocity is so gradual that it is impossible to determine the precise moment when it is reached. Therefore this test is at best a rough measure of the order of magnitude, rather than a precise measurement.

The tests all agreed in placing the time required to lose 20 m.p.h. of excess

speed between 12 and 18 sec. Most of the excess speed was lost in 10 sec.; thereafter the return to normal speed was gradual, being complete in about 14 or 15 sec.

Implications

Let us consider the implication of this observation, taking first the case of calm air. For the Kitty Hawk, which has a gliding angle of about 1 in 7 at 60 m.p.h. (measured in a long glide across the wind from 4,600 to 400 ft. in a distance of 5.6 mi.), we may estimate roughly the approximate loss of altitude during the time of deceleration. Starting at 80 m.p.h. and reducing the angle of glide to that which results in a steady speed of 60 m.p.h., this final velocity is almost attained in 12 sec. Assuming that during this time the average air speed is 70 m.p.h., the loss of altitude would be 175 ft. if the gliding angle were 1 in 7. Actually the loss of altitude will be a little less, for the gliding angle is somewhat flatter until the excess speed has been lost, because the angle of attack is less at the higher speed. The effect of this flattening of the glide, due to excess speed, will be to bring the path further toward that which the plane would have followed at a constant gliding speed of 60 m.p.h. As the excess speed is lost, the angle of attack will increase, and the path of the glide will be a curve, gradually becoming parallel to the straight path of the normal glide. For example, suppose the glide is started from 1,000 ft., if for the first 800 ft. a gliding angle is maintained which gives a steady speed of 80 m.p.h., and at 200 ft. the angle is changed to the 60-mi. angle, the speed will have been reduced to 60 m.p.h. at a point more than 25 ft. off the ground. The path of the glide will be approximately that in Fig. 1.

The second type of experiment was performed only once, but the observation sufficed to demonstrate the approximate difference in gliding angles at the two selected speeds. In a light wind a Kitty Hawk was flown to a point over a bridge on the shore 2.1 mi. from the Dennison Airport, approximately across the wind (thus rendering the effect of wind a minimum), at an altitude of 2,600 ft. The engine was throttled and the plane was glided toward the airport at a speed averaging 60 m.p.h. or a little less. On reaching a point directly over the airport, the altitude was 600 ft. Next the plane was flown back to a point over the same landmark at an altitude of 2,800 ft., and this time put into an 80-m.p.h. glide for the field. At an altitude of 700 ft. the distance from the airport was still so great that it was necessary to flatten out the glide until the air speed fell to 60 m.p.h. in order to reach the field at a safe altitude. When the airport was reached the altitude was between 200 and 300 ft.

This test showed that a 60 m.p.h. glide resulted in a loss of 2,000 ft. in 2.1 mi. (actually a little greater distance, for the course was slightly curved), whereas gliding at 80 m.p.h. resulted in a loss of 2,100 ft. in about 1.5 mi. In short, at 80 m.p.h. the gliding angle was about 1 in 4. The average gliding angle for the entire 2.1 mi., including the flat glide at the end for more than twice the distance needed to lose excess speed, was about 1 in 4.3. Obviously for every 100 ft. of descent there is a horizontal difference of 300 ft. between the position arrived at in a 1-in-7 glide and that arrived at in a 1-in-4 glide. Thus we arrive at the conclusion that, in calm air, gliding at 80 instead of 60 m.p.h. shifts the ultimate place of setting down nearly 300 ft. horizontally for every 100 ft. of descent until the last 200 ft. above the ground is reached, during which the excess of speed must be lost.

Effect of strong winds

The above considerations apply only to calm air or wind so light as to be negligible. A strong wind can alter conditions in such a way as to reverse the effects of a steep glide. A plane gliding at an air speed of 50 m.p.h. against a 50-mi. wind will obviously descend vertically with reference to the ground. In such a condition a steeper glide, giving an air speed of 60 m.p.h. will give a forward motion over the ground, and a glide at 80 m.p.h., in spite of the steeper angle with reference to the air, will increase the horizontal speed so much that the angle of glide with reference to the ground will be flatter than at 60 m.p.h. (Fig. 2).

Since gliding more steeply in a calm brings the point of setting down nearer, and gliding more steeply against a strong wind places it farther away, it is evident that at some intermediate wind velocity the two opposite effects must balance each other, so that the point of setting down will be the same whether the glide is at an air speed of 60 or 80 m.p.h. Assuming, for example, the angle just specified for these speeds (1 in 7 and 1 in 4 respectively), if the wind velocity is 46 m.p.h. the angle of glide relative to the ground will be the same, whichever one of the two gliding angles is used. It does not follow from this that the same result would follow from intermediate gliding angles. If the air speed for all possible gliding angles were measured, it would be possible to determine mathematically for any given wind velocity, what gliding angle would give the most nearly horizontal glide with respect to the ground.

The practical conclusion

The practical conclusion is that in a calm or light wind a straight dive can be used to lose excess altitude, provided it is done high enough to allow a liberal space in which to lose the resulting excess speed. But the latter necessity renders the expedient less satisfactory than the side slip. The case of gliding against a strong wind presents the possibility of using a steep gliding angle effectively. Engine failure in a gale of wind might find a pilot so placed that he could not reach the field in a normal glide, but could do so by gliding steeply and attaining sufficient speed. Under these conditions it might be useful for the pilot to know in advance the approximate air speed which would give him the best gliding angle for the wind velocity he was encountering. It should be noted that in the comparison cited, a very strong wind is required to render the steeper glide more efficient.

Of course, the actual application of the various points illustrated by these measurements and calculations is instinctive in the case of the experienced pilot, and the beginner must make them so by actual experience before he can be proficient, but it is sometimes useful to have tha quantitative basis of judgment put down in figures.

Years of experimental work on propellers for the U. S. Army Air Corps, and years as chief engineer of the Hamilton Standard Propeller Corporation make Mr. Caldwell eminently qualified to discuss propeller problems. In the present article he covers many aspects of the care and servicing of equipment of this type.

Care of the detachable-blade, metal propeller

By Frank W. Caldwell
Vice-president,
Hamilton Standard Propeller Corporation

METAL aircraft propellers of the type now generally in use require comparatively little maintenance, but it is desirable that the operator should be familiar with those factors affecting their smoothness, safety and efficiency. This article will be primarily directed to the servicing of the type of propellers made up of detachable aluminum alloy blades and separate steel hub.

It is desirable that a service station should be equipped with a first-class checking plate, a protractor, and a balancing stand. In addition suitable equipment for inspection of blades by the etching process is necessary.

Detachable blade propellers of the Hamilton Standard type are made with five standard blade-end, or socket sizes, selected to cover practically the whole range of propeller requirements. There are limitations on diameter, engine horsepower and r.p.m. for each socket size which are fixed by strength considerations. Table I shows the principal dimensions of standard blade ends, and Table II the power, r.p.m., and diameter limits for each size of shank. The limitations shown should never be exceeded in making blade applications.

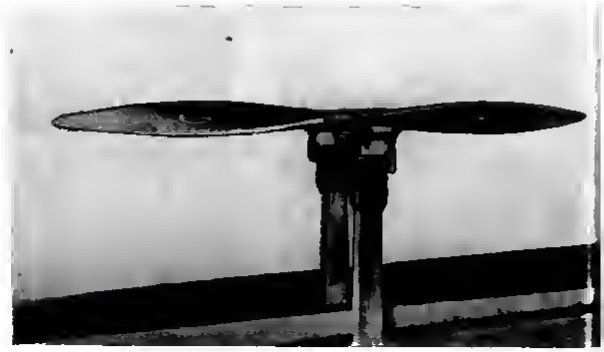
It is desirable to have some means of checking the suitability of a propeller blade for the plane and engine on which it is to be used. In general, the angle of attack of the propeller at full throttle and top speed of the plane should range between 1 deg. and 3 deg. Hubs are provided with a scale marked off in degrees, which indicates the pitch angle of the propeller blade at a point 42 in. from the crankshaft axis for propellers greater than 7 ft. in diameter. To find the angle of attack, divide the speed of the airplane in m.p.h. by the r.p.m. of the propeller, and multiply by 4. This figure represents the tangent of the angle of advance at the 42-in. radius, and the corresponding angle of advance may be obtained from a table of trigonometric functions. To find the angle of attack, subtract the angle of advance from the blade angle setting at 42-in. radius. If the angle of attack is greater than 3 deg., it is usually an indication that the diameter is too small, while if it is less than 1 deg., it usually indicates that the diameter is too large. There are, of course, exceptions to this rule, but it is a rough check as to whether the propeller is operating efficiently.

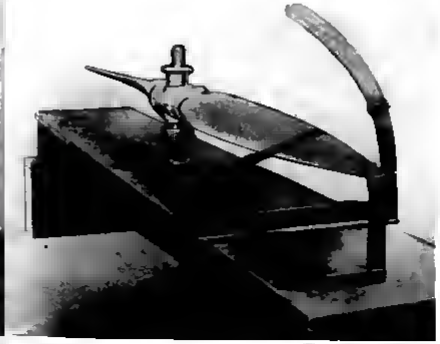
Assembly procedure

The blades of a given design of propeller are balanced against a master at the time of manufacture and are interchangeable for balance. On account of the necessary manufacturing tolerances in the hub, however, there may be a very slight discrepancy in balance in shifting blades from one hub to another which can be corrected as explained in a later part of this article.

In assembling propellers, the blades should be pulled out firmly against the shoulders before clamping them into position, as otherwise they will not balance properly when placed on the stand. It is true that they will be pulled out by the centrifugal force as soon as they are put in service, but it is impossible to check the balance unless the blades are in the proper position.

A second point which is quite important is the location of the clamping rings. These can be adjusted around the hub barrel to obtain perfect balance with the blades in the proper position. The latter are adjusted at the factory for perfect vertical balance, and an arrow is marked on the clamping ring and an-





Left: Checking a propeller for balance. Right: Adjusting the blades by means of a protractor

other on the hub The two arrows should line up to secure balance In re-balancing the propeller after considerable service, or in placing new blades in the hub it will be necessary to adjust the clamping rings slightly to secure a perfect balance The recommended procedure for this purpose is outlined in the following paragraph

Blades should be assembled in the hub at the proper angle and pulled out firmly against the shoulders The ring should then be drawn fairly tight at the position indicated by the arrows The propeller should then be placed on the balancing stand and the balance observed with the blades in a vertical position If the propeller is found to be out of balance the clamping rings may be loosened and rotated about the hub so that the bolt will move toward the light side of the blades In this way perfect vertical balance may be secured

In assembling a new set of blades in a hub, it will often be found that there is a very slight discrepancy in the balance of the blades in the horizontal position Many operators are now painting the tips of their blades to emphasize the danger of the whirling propeller and in this case a slight discrepancy in balance may be corrected in the painting process In case the blades are not painted it will be found that there is a small concentric hole in the butt end of each filled with lead Any slight unbalancing may be corrected by removing lead from the heavy blade

The pitch of the propeller may be adjusted by loosening the clamp rings and turning the blades in the hub by tapping them lightly with a rubber or leather mallet. The angles of all of the blades of a propeller should be alike within ½ deg to insure smooth operation To obtain this accuracy it is necessary to set the blades by means of checking plate and protractor, or with a special N A C A type portable protractor If the latter is used the pitch may be adjusted while the propeller is in place on an airplane

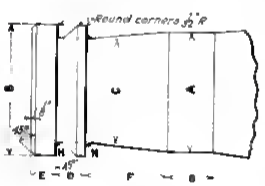


Table I

Standard Blade End Number	A (+ 000) (— 005)	B (+ 000) (— 005)	C (+ 010) (— 010)	D (+ 002) (— 000)	E (+ 010) (— 010)	F (+ 005) (— 000)	G (+ 010) (— 010)	H Radius (Inches)
No. 00 (Ab to 50 hp.)	2 2500	2 495	2 0000	0 5000	0 4375	1 3125	0 875	3/32
No. 0 (50 to 300 hp.)	3 0000	3 645	2 4250	0 6875	0 5620	1 6875	1 250	⅛
No. 1 (200 to 475 hp.)	3 8750	4 245	3 3750	0 8750	0 7500	2 3750	1 375	5/32
No 1½ (475 to 800 hp.)	4 1875	4 420	3 6875	1 0625	0 8750	2 6875	1 500	5/32
No. 2 (500 to 1500 hp.)	4 5000	4 995	3 8750	1 2500	1 0000	3 1250	1 500	5/32
No. 3 (1000 to 1500 hp.)	5 0000	5 620	4 0125	1 3750	1 1250	3 4380	1 688	3/16

Table II

Shank Number	Maximum Propeller Diameter (Ft.—In.)	Maximum Engine Horsepower	Maximum Propeller Tip Speed (Ft. per Sec.)	Maximum Cylinder Bore (Inches)
No 00	6–6	50		
No. 0	8–6	125	1500	3 500
No. 1	10–6	450	1500	3 750
No 1½	11–6	700	1500	4 125
No 2	15–0	1500	1200	
No 3	17–6	1250	1500	

Inspection by etching

In order to check the possible presence of fatigue cracks in blades, it is considered good practice to inspect them minutely for cracks following a caustic etch after each 200 hr of flying The purpose of etching is to clean the surface of the metal and show up any cracks which may have started.

In order to carry out the etching process, it will be necessary to prepare the following solutions:

(A) Caustic soda solution To each gallon of water, add 1 to 2 lb of commercial caustic soda. This corresponds to 10 to 20 per cent aqueous solution

(B) Nitric acid solution To each 5 gal. of water add 1 gal of commercial nitric acid. This corresponds to a 20 per cent aqueous solution

Caution: Wood, glass or earthenware containers must be used for both the caustic soda and nitric acid solution In mixing the acid, *always* pour the acid slowly into the water Rubber gloves should be worn at all times while working with these solutions.

The enamel or lacquer finish on propellers may be removed either with acetone or (where the equipment is at hand) by immersing for 15 to 30 min. in a boiling solution of Oakite. The concentration of the Oakite solution should be the same as is used for cleaning aluminum alloy engine parts For either method, the removal of the enamel or lacquer can be accelerated by brushing with a fiber brush, or swabbing with a cloth wrapped around the end of a stick. Great care should be exercised to avoid scratching the surface of the metal and under no condition should a wire brush or a metal scraper be used

Propellers which have been prepared for etching, as described above, may be etched as follows: Small quantities of the caustic soda solution may be applied to the propeller by means of swabs or fiber brushes A convenient swab is made up of cotton rags wound around a wooden stick approximately 2 ft in length The whole surface of the propeller should be (1) gone over rapidly with a caustic solution until the surface is well blackened, (2) rinsed immediately with water, and (3) swabbed in a similar manner with a nitric acid solution until it is bright and all traces of the black deposit are removed These operations may be repeated until the desired depth of etch is obtained.

After the etching process is completed the propellers should be examined thoroughly for any minute hairline cracks which may have started as the result of repeated stresses in the blades. Cracks of a dangerous nature are usually at right angles to the length of the blade They usually start as very small cracks and gradually grow as the use of the propeller is continued

Repair

If propellers are subjected to unusually severe conditions such as extended operation in spray or rain, or on cinder runways, the leading edges of the blades may become pitted and ragged If the roughness is eliminated by means of crocus or fine emery cloth while still in the early stages of development the blades will retain their efficiency and the effect on the balance will ordinarily not be noticeable in operation. If the blades are so badly pitted that it is necessary to file them smooth the propeller should be re-balanced.

It has been found advisable by the Navy where propellers are subjected both to the erosion of seaplane spray and to the corrosive effect of salt atmosphere, to smooth the blades with crocus cloth and then wipe them with an oily cloth after each day's flying Any scratches or surface irregularities should be smoothed out with emery cloth and finished with crocus cloth

It is usually possible to straighten aluminum alloy propeller blades which have been bent or twisted in a minor accident. Unless the deformation is very slight, however, it is necessary to anneal the blades before reforming and to heat treat them afterward They should then be etched and examined for cracks or surface defects. This repairing should be done at the factory.

In certain types of planes the reflected glare from the polished metal blades is troublesome, particularly for night landings Experiments have been carried out on a large number of finishes and dark maroon enamel has been found to give the least light reflection, and the least objectionable properties from the standpoint of glare

The question of vibration in the power plant, propeller and mounting is very important There are, of course, a number of possible causes of vibration,—one of the most obvious of which is the static unbalance of propellers, which can be controlled by inspection Dynamic unbalance of a propeller can be controlled within fairly close limits by checking the face alignment or track, of the blades at a number of stations Aerodynamic unbalance may be caused by unequal angle setting of the two blades or by improper template fit of the two blades, resulting in different airfoil characteristics This feature is carefully controlled by inspection at the factory but must be checked after each repair.

Vibration often comes from the engine so that the engine and mount should be carefully checked when it occurs.

Vibration frequently occurs only at certain speeds, however, and is comparatively unimportant at others. It is probable that this is the result of synchronizing the vibration of some parts with engine impulses or with the rate of revolution For example a period may exist between the crankshaft and propeller, or the polar moment of inertia of the engine may be such as to create a period with the mounting

In any particular application the torsional stiffness of the crankshaft or the moment of inertia of the engine cannot very well be controlled, but there is some possibility of changing the moment of inertia of the propeller or the stiffness of the mount If the period of vibration is near the maximum speed of the engine, a lighter propeller might be tried with a view to increasing the period beyond the normal range in flight or the mounting might be stiffened for the same reason If the vibration occurs near the minimum useful speed of the engine a heavier propeller or a rubber mount may be tried

Magnesium alloy propellers

Propellers made of magnesium alloy are beginning to come into use This material weighs only six-tenths as much as the aluminum alloy and has splendid fatigue properties It is, however, subject to corrosion if exposed to salt water or salt spray and must be thoroughly protected from contact with them The following procedure has been found to be fairly satisfactory as a means of protection The blades are first treated in a neutral magnesium phosphate solution, which results in a coating somewhat similar to the Parkerizing of steel parts On top of this coating, two or three coats of Duco, or enamel are applied The propeller should be wiped off with oil every day, or after each flight By the use of these precautions, it is possible to take advantage of the light weight of this material, even for operations near the sea coast.

A beacon system for the private flyer

A Richfield beacon and service station

DESIGNED primarily to serve the private and business pilot rather than air mail and air transport routes, the Richfield beacon system erected on the Pacific Coast during 1929 has been in successful operation for more than a year The beacons follow the established highways from one center of population to another, rather than following the shortest distance between large metropolitan centers, and thus directly serve those pilots who are seeking to visit intermediate towns There are 34 beacons in the chain, or approximately one every 50 miles over the 1,600-mile route from the Mexican to the Canadian border From the Mexican border the beacons outline two routes to San Francisco, one inland and one via the coast, while but one inland route is lighted from San Francisco north to the Canadian border

Eight of the beacons are on, or immediately adjacent to airports, 28 are near established airports, the airport being designated by a small directing beacon, and the remaining beacons, except those located on downtown buildings, as in Los Angeles, are located on or near projected airports Of the 34 established beacons eight are beacons only, 26 have complete automotive service stations for fuels and lubricants and are equipped to service planes and one of the beacon-service station units, that at Barstow, Cal., includes a complete $180,000 tourist hotel available alike to autoists and air travellers.

This chain of beacons was erected on a joint basis by the Richfield Oil Company of California, and Highway Communities, Inc Following the erection of beacons complete service stations for motorists have been installed as rapidly as prospective business warranted. The beacon towers are of steel construction, triangular in shape, 125 ft in height with the word "Richfield" in large red neon lights extending the length of two, and in some cases three sides of the tower These red neon towers are themselves distinctive and easily located by pilots from distances as great as 50 mi Surmounting each tower is a revolving light of 8,000,000 cp, elevated from 1 deg to 2 deg above the horizon while a directional light of equal candlepower points the way to the nearest airport All beacons rotate in a clockwise direction at either 2 or 6 r p m. according to location. Each beacon tower is designated by a symbol which is usually a direct abbreviation of the name of the nearest town. All beacons and their symbols are approved and listed by the Department of Commerce, Aeronautics Branch

Map showing beacon routes

From the Lakes to the Pacific

By
Robert Johnson
The Boeing Companies

TWELVE million miles of day and night flying were completed last January by planes of Boeing System operating over the Chicago-Oakland San Francisco and Seattle-San Diego air mail, passenger and air express routes. Of this total, which is considered a national mileage record for a single air transport organization, nearly 9,000,000 mi. were flown on the transcontinental airway, popularly known as "the backbone" of the nation's air mail service.

Strong emphasis on a half dozen prominent operations factors has laid the foundation of the company's record for efficiency and safety in air transport activities. In short, proper flying equipment, thorough maintenance methods, carefully selected and supervised pilot personnel, well-established airways, extensive communications systems and effective weather reporting service are important reasons why Boeing System ranks as one of the leaders in the field of American air transportation. Instead of acquiring airplanes and adapting them to the airway, the company had aircraft designed and constructed to fit the requirements of the route. Instead of having to repair its planes and engines after failures, an unusually comprehensive system of maintenance was developed to forestall failures as much as possible. Instead of having to ground pilots because of poor health, flight surgeons are employed to insure reasonably good physical condition in the pilot personnel at all times. In other words, the elimination of uncertainty has been the fundamental policy in all phases of operations.

Flying equipment

By reason of extreme variance in altitude, topography and weather conditions encountered on the 2030-mi. airway, it was necessary to have airplanes designed and built for specific

Passengers boarding a Boeing plane at Oakland, Cal.

operations. The Boeing Airplane Company produced three types now in use on the transcontinental line: Model 80-A-1, a large capacity tri-engined transport; Model 95, a fast, heavy duty mail plane; and Model 40-B, a combination mail and passenger machine with one engine. The planes, without exception, are powered by 525-hp Hornet engines. In their construction, speed is secondary to strength and safety. The company now operates twelve tri-engined planes, eight 95s and nineteen 40-Bs.

The roomy passenger compartment of the tri-engined 80-A-1, with balsa wood sound-proofed walls and ceilings, is finished in highly polished mahogany with burnished aluminum fixtures. Features for the convenience of the passengers include comfortable reclining chairs, individual electric reading lamps, iced drinking water and hot and cold running water in the lavatory.

One of the difficult problems in the construction of the plane was the development of effective heating and ventilating systems to counteract the various temperatures along the line. A forced heating unit was developed, with belled "stoves," or cylinders, placed around the exhaust stack leading under the fuselage from the center engine. Fresh air enters the belled mouth of the stove and is heated by contact with the exhaust stack, and is then directed up into the cabin through a conduit with outlets at the rear of the compartment. When warm air is not required in the cabin, a butterfly valve at the junction of the conduit and the stove may be regulated to allow the warm air to escape from a venturi at the rear end. For ventilation, large air intakes are located at the rear of the cabin, controlled with a combination shutter-scoop. In addition individual ventilators are installed at each window, which may be controlled by passengers.

The crew of each tri-engined transport includes a pilot, co-pilot and stewardess. Boeing System developed an innovation in air travel which has been well received by employing young women as regular members of the flying crews, in place of the usual male couriers. These institutionally trained stewardesses attend to the needs of the passengers, supply reading matter and writing materials, serve meals in flight, answer questions concerning points of interest along the line, and serve the air travelers in various other ways.

Schedules flown

The post office department authorizes two round-trip flights daily over the Chicago-San Francisco route. One of the schedules is flown with 80-A-1s, especially constructed for the convenience of passengers. Although designed for eighteen passengers, weight limitations imposed by the heavy air mail volume hold them to eight passengers on the Chicago-Salt Lake City section and twelve passengers on the Salt Lake City-San Francisco division. The mail loads westbound are lightened

The factors which have contributed to the success of the Boeing Air Transport Lines between Chicago and the West Coast as discussed in the accompanying article are worthy of serious consideration by anyone concerned in the transportation of passengers or goods by air.

and the loads eastbound are increased at Salt Lake City where feeder lines to the north, northwest, and southwest connect with the transcontinental.

The second daily round trip is maintained with 40-Bs and 95s, and passenger traffic on this schedule is incidental to the mail. On both schedules, the planes are alternated at Cheyenne, operating headquarters for the airway and the base of a large and complete repair depot for the overhaul and maintenance of the aircraft. The current schedules are shown in Table I.

Table I—Chicago-San Francisco Schedules, Boeing Air Transport, Inc., Division United Aircraft & Transport Corporation

Westbound—(read down) Daily	Daily X	Miles		Closed cabin Boeing planes		Eastbound (read up) Miles	Daily	Daily X
				(Central Time)				
9 30 a.m	5 00 p.m.		Lv	Chicago	Ar	3030	5 00 p.m.	5 00 p.m
11 45 a.m	10 15 p.m.	202	Lv	Iowa City	Ar	1930	*3 00 p.m.	*3 00 a.m
1 00 p.m	*11 30 p.m.	303	Lv	Des Moines	Ar	1727	2 00 p.m.	2 00 a.m.
2 10 p.m.	12 30 a.m.	433	Ar	Omaha	Lv	1597	1 00 p.m.	1 00 a.m
2 30 p.m.	1 00 a.m	455	Lv	Omaha	Ar	1597	12 40 p.m.	12 30 a.m.
3 00 p.m	*1 30 a.m.	481	Lv	Lincoln	Ar	1549	12 05 p.m.	*12 05 a.m
5 aa p.m.	5 15 a.m.	701	Ar	North Platte	Lv	1329	*11 00 a.m.	11 00 p.m
				(Mountain Time)				
4 15 p m	2 30 a.m	701	Lv	North Platte	Ar	1529	*9 45 a.m.	9 45 p m
6 15 p m	4 30 a.m.	917	Ar	Cheyenne	Lv	1113	7 45 a.m.	7 45 p.m
6 30 p.m.	4 95 a.m	917	Lv	Cheyenne	Ar	1115	7 30 a.m.	7 30 p.m.
9 00 p m	7 15 a.m.	1176	Lv	Rock Springs	Ar	854	*6 00 a.m.	*6 00 p.m
11 00 p.m	9 30 a.m.	1176	Ar	Salt Lake City	Lv	692	4 00 a.m	4 00 p.m
				(Pacific Time)				
10 30 p.m	9 00 a.m	1330	Lv	Salt Lake City	Ar	692	2 30 a.m.	2 30 p.m
12 30 p.m	11 00 a.m.	1570	Lv	Elko	Ar	460	12 30 a.m	12 30 p.m.
2 45 a.m.	1 15 p.m.	1839	Ar	Reno	Lv	191	10 15 p.m.	10 15 a.m.
3 00 a.m	1 30 p m.	1830	Lv	Reno	Ar	191	10 00 p.m	10 00 a m.
4 00 a.m.	2 30 p.m.	1930	Lv	Sacramento	Ar	80	5 30 p.m.	8 30 a.m
6 00 a.m.	4 30 p.m	2030	Ar	Oakland-San Francisco	Lv	0	8 00 p.m.	8 00 a.m

* Planes stop only to accept or discharge passengers.

Note • Mail planes flown on schedule in columns marked "X" carry passengers when mail loads permit. On the 9:30 a.m. schedule from Chicago and 8:00 p.m. schedule from Oakland Airport eight-ton tri-engined passenger transports are flown.

San Francisco passengers on Boeing System lines board and leave planes at Oakland airport, on east side of San Francisco Bay.

Inspection and servicing

Preparedness is the keynote of the thorough inspection, servicing and repair methods enforced on the airway. One example of the elimination of uncertainty in the company's operation policy is that immediately upon the arrival of a plane at a division airport on completing its flight duty for the day, it is fueled and oiled before the work of cleaning and inspection is begun. This measure is taken to prevent the possibility of a plane being sent out on emergency duty without a full supply of gasoline and oil.

Two staff mechanics, under the direction of the chief mechanic, conduct a rigid routine inspection on the machines after every flight to insure their satisfactory condition. One of the mechanics is an engine specialist and the other an expert in rigging and assembly. During a flight over a division, stops are made at an average of four fields where servicing and repair facilities are available. Any necessary servicing is promptly conducted.

One of the interesting features of the maintenance program is the fact that engines are completely overhauled at intervals of approximately 200 hr. of service. The work of engine overhaul is conducted at the Cheyenne depot, and the plane is out of service for two days, during which time all parts of the structure are examined for necessary repair or replacements. These frequent intervals of complete overhaul are enforced solely as a protective measure. An engine ordinarily does not require overhaul so often, but, although it could probably be operated longer without trouble, the company has found that this system, seemingly drastic, forestalls a majority of engine difficulties.

Airplanes are removed from service for complete overhaul after approximately 1,000 hr. of duty. This work is done also at the Cheyenne depot. The planes undergoing overhaul are stripped of their fabric and entirely disassembled. The entire wiring system is replaced, worn or damaged parts are supplanted by new ones, necessary replacements in fuel and oil lines are made, and all other required work is done before the plane is reassembled. As a result, an overhauled plane is practically as effective as a new one. An average of 2,500 man-hours are required for the overhaul. In addition, after every 20 hr. of service, planes are returned to Cheyenne for a detailed inspection supplementing the daily examinations after flights.

Factory-airline liaison

Another important feature of the maintenance program is the liaison system between Boeing System and the Boeing Airplane Company. Engineers from the factory serve in a liaison capacity with the air transport company, not only aiding in the maintenance and repair of the aircraft which they have designed, but also studying their performance to determine possible improvements for new models. By coordinating the theory of design and construction with the practical experience in operation, considerable improvement is possible in the manufacture of succeeding models.

The company maintains a staff of 56 pilots, reserve pilots and co-pilots whose average flying time is 4,500 hr. Included among them are eight of the ten ranking air mail pilots in the country in point of continuous service, some of them having flown with the mail service for twelve years. E. Hamilton Lee, the senior mail pilot now flying between Chicago and Omaha, has flown approximately 1,000,000 mi. The chief pilot of the line is Harold Lewis, second ranking mail pilot. Applicants for positions in the personnel must demonstrate their ability to Lewis in a dual controlled mail plane.

In addition to the Department of Commerce examinations, the Boeing flyers are examined monthly by the company flight surgeons, three of whom are employed to supervise the health of the flying staff. The health factor in which the surgeons are most keenly interested is the fatigue, or "air-staleness" caused by too much flying, too little exercise and loss of sleep. The company has determined that after 4 hr. of flying, a pilot begins to lose efficiency, and consequently flying schedules are so arranged that no pilot flies more than 4 hr. in one day, and has at least one day of rest between runs. As a general rule, Boeing pilots fly about 70 hr. per month. It was also discovered that high altitudes tire a flyer quickly, and as a result, pilots fly at the lowest altitude consistent with safety, thus maintaining their highest efficiency. This system prevents staleness from too much flying, but lack of physical effort will produce similar results which it is highly important to check.

To test the pilots for fatigue, the exacting Schneider index, used in the U. S. military air services, is employed. The test is composed of a series of pulse and blood pressure readings before and after exercise. A pilot's condition is graded by a system of scoring. In the Air Corps, if a pilot's score drops below eight, he is not considered in good flying condition. In the Boeing tests, if a man falls below ten, he is grounded and requested to report the following day. If his score is again low, he is grounded for several days and exercise is prescribed. Relaxation, exercise and amusement are the best cures for air-staleness, and Boeing surgeons believe that golf and bowling are the most beneficial exercises for pilots. The majority of the company pilots prefer golfing, and many are adept at the sport. It is not uncommon to see a pilot carry along his golf clubs when he is flying from one end of the division to the other.

Half of Boeing System's mileage is flown at night, its airway having been lighted by the Department of Commerce. The company pioneered the flying of passengers at night over long routes by inaugurating a service over the Salt Lake City-San Francisco section of its line several years ago. Hundreds of thousands of miles were flown at night without injury to passengers or pilots. This record demonstrated the feasibility of extensive night passenger operations and laid the ground work for the expanded schedules over the entire transcontinental airway. The company has found that passengers enjoy traveling at night, and that many prefer night flying to day flying.

Radio communication

Probably the most important recent development in safety measures has been the adoption of the radio telephone. Two years prior to the inauguration of its expanded passenger service, the company set about to develop an effective plane-to-ground radio communication system, although up to that time radio telephony for aircraft purposes had not been very successful. The electrical interference from the plane itself was so great that proponents of the code system of communication argued that radio telephony would never be successful in aviation.

This problem was studied by starting with a bare fuselage on the floor of the factory and assembling it, testing each part added for electrical interference. When metal parts could rub against each other sufficient interferance would develop to paralyze reception, but by careful bonding, the structure was finally completed in which the trouble was eliminated. Silencing the ignition system proved to be more difficult. A shield for spark plugs was developed which not only reduced disturbance but also which was light in weight and sufficiently sturdy to withstand repeated servicing. The shielding of the leads from the magnetos to the plugs was accomplished by mounting an aluminum conduit behind the cylinders from which leads made up of flexible tubing and copper braid were routed to the spark plugs. After the magnetos were shielded, interference was reduced to a point where it was not audible in the receivers. Significant evidence of the success of the preparation is found in the fact that ordinarily reception in the airplane is clearer and less hampered by interference than reception in the radio telephone stations on the ground.

Compact and easily operated equipment for the plane was developed in cooperation with the radio equipment manufacturers. In the 80-A-1, it is located at the rear of the plane and is operated by remote control from the pilots' compartment. The transmitter is relatively small and weighs but 32 lb. Two types of receivers are employed. One is of high frequency for the reception of the two-way ground transmitters and for two-way communication with other Boeing planes, while the other is of low frequency for the reception of the Department of Commerce weather stations and the radio range equipment. The receivers weigh 13 lb.

The plane's radio equipment is tuned by the ground station operators before departure, and, once in the air, the set is practically automatic in operation. To transmit the pilot merely presses a button on the control column, and to receive he removes his finger from the button. A small control permits him to regulate the volume of the signals.

Earphones and microphone are built into the pilot's helmet. The microphone is so attached that it is constantly suspended in front of his lips permitting free use of his hands for the control of the airplane.

The company has installed fourteen ground stations along its airway, located at Oakland, Sacramento, Reno, Elko, Salt Lake City, Rock Springs, Cheyenne, North Platte, Omaha, Des Moines, Iowa City, Lincoln, Cedar Rapids and Aurora, on the outskirts of Chicago. The equipment is effective at ranges of 200 mi. or less and at altitudes as great as 14,000 ft. The airway is also partially equipped with the Department of Commerce's directive radio beacon service.

Demonstration of the effectiveness of the radiophone in guiding a plane to a landing through a belt of fog over a terminal airport has been given repeatedly. Recently at Oakland, a plane reached the airport to find it fog-bound. Officials at the field heard the sound of the engine overhead and advised the pilot of his position by radiophone. They then informed him that the airport was clear for landing purposes, that there was an 800-ft. ceiling, and that there was no wind. In possession of such knowledge, the pilot was able to negotiate a safe landing.

A Boeing combination mail and passenger plane

The engine is warmed up under wraps by a blow torch. The wise pilot carries a shovel.

Winter flying in northern Canada

By Capt. T. M. Reid

UNTIL recently winter flying in northern Canada had been regarded as both hazardous and impractical an impression formed mainly because of the lack of reliable data. Today, in the far and middle north, travel by air is the accepted and economic mode of transportation. Already regular passenger and mail services are being operated down the Mackenzie River to Aklavik, on the Arctic coast over 200 miles north of the Arctic circle. Both the east and west coasts of the Hudson Bay have been successfully conquered by aerial exploration companies.

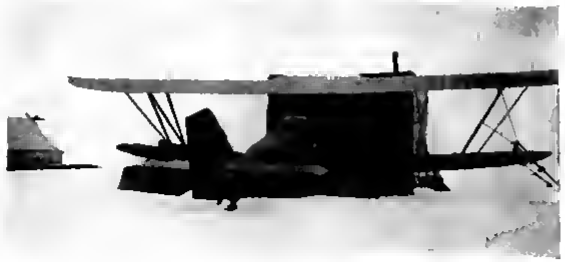
The first problem was the development of a suitable ski gear. After numerous experiments, this was eventually achieved in the design of a laminated ash runner with a solid wooden pedestal, which is now standard in this country. The skis are constructed of selected three-ply ash with three longitudinal brass runners riveted to the bottom and the pedestals are mounted on the airplane approximately six inches behind the center of pressure to assist in climbing to the surface of powdered snow or slush. In order to prevent the skis from freezing to the snow when the machine is at rest it has been found advisable to place small pieces of wood or brush underneath them. For operations on loosely packed snow it has been found essential also to fit the tail skid with a small ski.

The more important problems, however, are concerned with the modification of the engine installation to insure carburation, and sufficiently high oil temperature to enable the engine to be run without injury. Oil tank and all feed and return lines are now lagged with asbestos, and the crankcase is cowled off for minimum contact with the flow of cold air. Faulty carburation in extremely low temperatures can be overcome to a great extent by arranging that the intake air be supplied from inside the cowling, as even the most elaborate system of preheating air for the carburetor cannot be relied upon to provide sufficient heat when the temperature is at 20 deg. below zero, and the air is drawn directly from the slip stream.

For heating the engine prior to starting and for making adjustments and repairs a combined nose hangar and field work-shop has been devised. This consists of a small three-sided wooden shack with a raised flooring into which the nose of the machine can be pushed, and shut off from the outside by means of draped canvas curtains.

For remote operations and forced landings a close fitting canvas covering the whole engine, and having an apron extended to the ground, has been designed. This covering forms a small tent underneath which a blow torch may be placed to heat up the engine.

One of the greatest drawbacks is the amount of dead weight which must be carried, and the amount of cargo space absorbed by special equipment which includes engine cover, heater stove and shield, jack and handle, snow shoes, axe, emergency rations, and many other incidentals.



A nose hangar in use

Heat and Ventilation

ARTICLE TWO

Their place in the transport plane

By
E. C. Blackburn, Jr
Consulting Engineer

EVEN distribution of heat and air for ventilation in a cabin is essential regardless of the type of heating and ventilating system that is used. Bearing this in mind it is reasonable to believe that of two systems delivering to the cabin the same quantity of heat and heated air for ventilation, equal distribution being accomplished in both cases, the combined hot-air heating and ventilating system will be lighter in total weight than the steam system will be.

The hot-air heating and ventilating system will compare favorably in weight with the direct steam heating system which does not make any provision for ventilation. If the steam system is so designed that it will provide heated air for ventilation in addition to the required amount of heat for warming the cabin, the weight will be still further increased and the difference in favor of the hot-air system will become still more pronounced.

Steam systems have many advantages and are very desirable in building work where weight is of no consequence. But in airplane work there doesn't seem to be anything at all to make the use of steam heating system advantageous.

Hot-water systems are, in many respects, similar to steam systems. That is, a boiler, radiators, and a system of piping are necessary in a hot-water system. These may be arranged in a manner somewhat similar to the arrangement in the steam system shown in Fig. 5 (reprinted from article one, AVIATION, May, 1931). There will, of course, be differences in the details of arrangement of the piping as well as sizes of the pipes. The principal difference between a steam and a hot-water heating system is the fact that in the hot-water heating system the entire system is filled with water. Whereas, in the steam system, the boiler only contains water and this is only partially filled.

The hot water in a hot-water heating system necessarily being at a lower temperature than the steam in a steam heating system, results of course in a reduced temperature at the radiators. To offset this reduced temperature it is necessary, in order to obtain the required amount of heat, to install hot-water radiators larger in size and consequently heavier, than would be required with a steam heating system.

This, together with the weight of water required to fill the system entirely, makes a hot-water heating system even more undesirable from the standpoint of weight, than the steam heating system.

A comparison of weights and other properties of various types of systems; the last of two articles

Consideration has been given by some manufacturers to the utilization of the heat in the cooling water for water-cooled engines for cabin heating. Fortunately the disadvantages have been so apparent that this idea has been abandoned.

The volume of water required to fill such a system would be an undesirable increase in weight. It is conceivable that this volume of water might be increased to a point where the water-cooling effect of the heating system alone might make it impossible to operate the engines at the most desirable temperature. This may not be possible in planes of the usual size built today, but if the size of the cabin and the heating system reached a certain point it is quite possible that this condition might exist.

Probably the most important reason that cooling water from a water-cooled engine should not be used in a cabin heating system is the fact that, should the heating system develop a leak, the water would be lost and the engine of course could not be operated without water.

We may say then that the same arguments advanced for the use of a hot-air system in comparing it with a steam system will apply even more forcibly in the case of a hot-water system.

By this process of elimination we have left the hot-air heating system, or the combined hot-air heating and ventilating system. Assuming that we have determined to install a combined hot-air heating and ventilating system in the cabin of this airplane we will proceed to determine the amount of heat that will be required in addition to the heat loss from the cabin, for warming the air to be used for ventilation.

One B.t.u. will raise the temperature of 1 cu. ft. of air approximately 55.2 deg. F., or, one B.t.u. will raise the temperature of approximately 55.2 cu.ft. of air 1 deg. F.

We have previously determined that the proper amount of air to be supplied to this cabin for ventilation is 540 C.f.m. or $540 \times 60 = 32{,}400$ C.f.h. (cu.ft. per hr.).

Taking this 32,400 C.f.h. from outside the cabin, the heating system must be capable of raising the temperature of this volume of air from —20 deg. F. to 70 deg. F. before it is introduced into the cabin. The amount of heat required in the accomplishment of this will be:

$$B.t.u.\ per\ hr. = \frac{C.f.h. \times Tr}{55.2}\ \text{or,}$$

$$B.t.u.\ per\ hr. = \frac{32{,}400 \times 90}{55.2} = 52{,}826\ B.t.u.$$

where Tr = temperature rise.

We have determined that the heat loss from the cabin is 18,101 B.t.u. per hr. We have also decided that this is to be a combined heating and ven-

tilating system. Therefore it is necessary that the air to be used for ventilation shall carry into the cabin this 18,101 B.t.u. per hr. This must be a surplus over and above the amount of heat contained in the air at the desired cabin temperature.

Therefore, in weather of —20 deg. F. the heating system must be capable of imparting to the air to be used for heating and ventilating an amount sufficient to raise the temperature of the air from —20 deg. F. to 70 deg. F. plus the amount of the heat loss from the cabin. Or,

$$18{,}101 + 52{,}826 = 70{,}927 \text{ B.t.u. per hr.}$$

This is the total amount of heat that must be given off per hour by the air heater, when operating under extreme conditions. In designing the air heater however, it will be wise to provide a heater capable of a heat delivery somewhat higher than this. In this way we can allow for heat loss from the air while traveling from the air heater to the cabin.

This will also provide for the maintenance of satisfactory conditions during rare periods when the minimum temperature may be slightly lower then that for which the system has been designed.

The next step in the design of the system is to check the maximum temperature that will be required for the air entering the cabin. This may be done by using the formula

$$T_e = \frac{55.2 \times H}{C.f.h.} + T_c \quad \text{where}$$

T_e = Temperature of entering air
H = Total heat loss from cabin.
T_c = Cabin temperature required
$C.f.h.$ = Cu.ft. per hr. of air supplied to cabin.

Using this formula in the case of the cabin we are considering, the required temperature of the air entering the cabin when the outdoor temperature is —20 deg. F. will be

$$T_e = \frac{55.2 \times 18{,}101}{32{,}400} + 70 = 100.8 \text{ deg. F}$$

This is an inlet temperature that is well within reason and should prove entirely satisfactory. If it is found in some cases thet the inlet temperature required is excessively high it should be reduced by supplying a larger volume of air.

That is, the required amount of heat necessary to compensate for the heat loss from the cabin, may be introduced into the cabin by a small volume of air at a relatively high temperature, or the same amount of heat may be introduced into the cabin by a larger volume of air at a lower temperature. Generally speaking the air inlet temperature should not exceed 110 deg. F.

From this required inlet temperature we can now check back on the amount of heat that we estimated the air heater would be required to impart to the air. Thus, using the formula previously explained for determining the amount of heat required for heating air, we wish to find the amount of heat required to raise the temperature of 32,400 C.f.h. from —20 deg. F. to 100.8 deg. F., or 120.8 deg. F.

$$\text{B.t.u. per hr} = \frac{32{,}400 \times 120.8}{55.2} = 70{,}904 \text{ B.t.u.}$$

This checks very closely with the 70,927 B.t.u. per hr. that we previously determined would be required.

It should be rememberd that this is the actual amount of heat which must be imparted to the air in passing through the air heater. By this is meant that it might be possible to design a heater that would give off this amount of heat but all of it might not be imparted to the air. In other words the efficiency of the air heater must be taken into consideration.

Referring back to the fourth, fifth, and sixth requirements of a successful ventilating system as enumerated in the preceding article of this series, we must now consider these in their proper sequence.

The fourth requirement, it will be remembered, is that the air to be used for ventilation must be free from odors, dust, bacteria, etc.

All of these requirements can be very satisfactorily met if given the proper consideration in the arrangement of the system.

To obtain air for ventilation which is free from odors will depend chiefly upon the location of the fresh air intake. Care must be exercised in locating the fresh air intake so that there will be no possibility of odors of burnt or hot oil from the engines entering the ventilating system.

Care must also be exercised in the design of the air heater, in cases where engine exhaust gases are utilized inside the air heater so that there will be no possibility of these exhaust gases leaking through the air heater and mixing with the air used for ventilation, thus being carried into the cabin.

In properly designed gas-fired, hot-air furnaces for use in residences there is no danger of the products of combustion being carried into the house through leaks in the heating surface. It is just as reasonable to suppose thet an air heater can be designed for utilizing the engine exhaust gases which will be satisfactory in this respect.

The air heater designed to utilize the engine exhaust gases must have exhaust gas passages sufficiently large so that no appreciable amount of beck pressure will exist, as this would naturally reduce the engine horsepower to some extent.

This lack of pressure inside the air heater will make possible the construction of an air heater which will be very light in weight, and at the same time can be made entirely leak-proof. This will eliminate any possibility of odors from this source.

Usually, in airplane work, the engines will be practically the only source of contamination that must be guarded against, in locating the fresh air intake.

Dust filters

Dust, especially when taxiing and taking off, is really a serious problem and must be properly provided for if the system is to be entirely satisfactory.

Fortunately the removal of dust from air may be accomplished very easily. This may be done in connection with an airplane with a minimum of weight and a maximum of simplicity by using a form of so-called dry air filter.

Several types of these filters are on the market at present and while they are heavier than would be desirable for use in an airplane, there is no reason to believe that a manufacturer of one of these filters could not be prevailed upon to make up a special product with due consideration to the matter of weight. This could certainly be done without in any way impairing the efficiency of the filter in regard to its durability or dust-removing characteristics.

These air filters are all fundamentally the same in regard to the principal utilized for the removal of dust. That is, they all consist of a cell frame which is filled with some form of material that will break up the flow of air into innumerable small streams flowing through the filter in a path of many changes in direction.

The cell is periodically removed from the system and cleaned in a special cleaning fluid, after which it is immersed in a viscous charging fluid. After being charged and replaced in the system the air is forced to flow through the media covered with the viscous fluid. The dust particles in the air are brought forcibly in contact with this viscous charging fluid by the many abrupt changes in direction of the air passing through the filter.

Naturally a large percentage of the dust particles are retained in the filter by the viscous fluid. The claims advanced by manufacturers of these filters are to the effect that they are in the vicinity of 95 per cent efficient in the removal of dust.

One type of such a filter cell is shown in Fig. 4. The frequency with which the filter must be cleaned and recharged will depend entirely on the dust content of the air where the filter is operating, of course. In some localities frequent cleaning will be necessary while in others the filters may operate for quite long periods without attention.

Bacteria removal, for all practical purposes, may be accomplished by the method of dust removal just described. Bacteria in the air will be found to exist largely on the dust particles, so if an efficient system for the removal of dust is provided the question of bacteria will be taken care of automatically. Tests made of air before and after

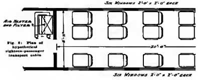


Fig. 2: Plan of hypothetical eighteen-passenger transport cabin

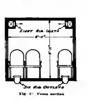


Fig. 1: Cross section

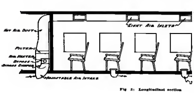


Fig. 3: Longitudinal section

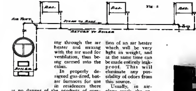


Fig. 4 (below): An efficient type of dust filter now available for airplane use. Fig. 5 (left): Arrangement of boiler, radiators and piping in a hot-water system

filtering will always show a corresponding reduction of bacteria.

Needless to say, the system must be so designed that the filter may be conveniently removed for cleaning and charging.

Equal distribution

The fifth requirement, relating to equal distribution of the air, without drafts, is, like the second requirement, entirely dependent on the number of air inlets and outlets, the velocity of the air through them, and their locations.

Generally speaking, the greater the number of air inlets and outlets provided, giving many points of inlet and outlet of small quantities of air, rather than a few inlets and outlet of comparatively large volumes of air, the better will be the distribution throughout the cabin. The problem of drafts will be largely dependent on the velocity of the air through these inlets and outlets.

The sixth requirement dealing with the control of the relative humidity, as we have previously stated, is very difficult to attain in aircraft.

The relative humidity can be increased only by the introduction of moisture, in the form of steam, into the air. A little calculation of the weight of moisture required to maintain the relative humidity of a given volume of air at the most desirable point will soon convince one that this weight is too great to justify this feature in heating and ventilating aircraft.

A reduction in relative humidity can only be accomplished by chilling the air, thereby reducing it to a point below the dew point, condensing a portion of the moisture.

Obviously, the only means of chilling the air in seasons when a reduction in relative humidity is desirable, is some form of refrigeration. Any present-day refrigerating machinery is far too heavy and bulky to make its use in aircraft, practical for de-humidification.

In addition to these undesirable features of humidity control in aircraft there is still the matter of automatic control. Automatic control of humidity is essential where means of varying the humidity are provided. This automatic control system would be another serious item of weight in this connection.

The majority of heating and ventilating systems installed in buildings do not have provision for humidity control. It is a very desirable feature and should be installed wherever the money is available and weight is of no importance. But for use in aircraft it is impracticable for the present.

Individual problems

It is obvious that each individual type of plane will require separate consideration in the design of its heating and ventilating system. No one system can be designed and patented and put on the market for installation in aircraft regardless of type.

It is true that some pieces of apparatus can probably be designed, patented, and placed on the market, for use in connection with heating and ventilating systems for airplanes. But this is about as far as standardization can be carried out in this respect. Standardization can, and should be realized in the matter of what may be considered good practice in heating and ventilating engineering as it applies to aircraft. This standardization of accepted practices can be realized far better if this work is carried on in conjunction with reliable heating and ventilating engineers, than it can if each manufacturer continues serenely on his own way disregarding what others may be doing in this respect.

Manufacturers who avail themselves of the services of a reliable heating and ventilating engineer, will at once derive the benefit of a great deal of experiment and research which has been carried out relative to heating and ventilating subjects, some of which, are applicable to aeronautical work. In this way he may save himself the expense and time necessary for finding out certain facts which may possibly already be known to the heating and ventilating engineer. Such a duplication of research work would of course be purely a waste of money.

A practical arrangement

In Figs. 1, 2, and 3 (reprinted from article one, AVIATION, May, 1931) is illustrated one arrangement which might be quite within the realm of possibilty for an eighteen-passenger plane, utilizing the exhaust from the engine mounted on the nose of the fuselage for purposes of cabin heating.

The air heater, filter, supply and exhaust ducts, inlets and outlets in the cabin, fresh air intake, and exhaust air outlet are all indicated in these illustrations.

It will be noted that a bypass is arranged around the air heater for purposes of temperature control. The bypass damper makes possible any desired mixture of heated air with unheated air. In this way the temperature of the air entering the cabin can be controlled, the temperature being varied to correspond with the variation of the outdoor temperature.

This bypass damper should be provided with some form of automatic control, actuated by a thermostat located in the cabin. In this way more even temperatures will be maintained than will be possible with manual control, regardless of how much attention the heating system might be given. Automatic temperature control is always very desirable and can be accomplished quite easily.

Attention is called to the fact that the bypass around the air heater makes is possible to supply the amount of air required for ventilation at all times regardless of temperature. If the bypass was not installed the only means of preventing overheating of the cabin would be to decrease the air supply. This would of course result in a corresponding decrease in ventilation.

With the bypass arrangement the same volume of air is supplied to the cabin at all times, the temperature of this air being regulated by the amount of air passing through the air heater and the amount being bypassed around the heater. The bypass damper must be set in a position that will control the proportion of heated and bypassed air so that the resulting mixture will give the required temperature.

Automatic control

This can be accomplished automatically very readily by the use of a graduated action thermostat system of control. In mild weather it will not be necessary to pass any of the air through the heater. In extremely cold weather it will be found necessary to pass all of the air through the heater. For all intermediate temperature conditions a proper proportion of heated and unheated air mixed together will give the required results.

It would be advisable to have the air heater as well as the filter arranged so that it can be easily removed for cleaning and examination for possible corrosion. Making the air heater easily removable also has the advantage that it can be removed from the plane during warm seasons of the year making it unnecessary to carry this useless weight during these seasons.

The energy required to force the necessary volume of air through the system and into the cabin can be obtained by locating the fresh air intake in the high velocity air stream passing over the outside surface of the fuselage.

The area of the opening of this fresh air intake should be adjustable and should be provided with a mechanism for varying the area of the opening from inside the plane while in flight. This arrangement will provide a means of positive control of the volume of air flowing through the system. The area of this opening should be set to give the required volume of air, this volume being checked by some aperoved means of measurement of the air volume. The fresh air intake opening can then be set securely in this position and will need no further attention, unless for some good reason a change in air volume is deemed advisable.

The air inlets and outlets in the cabin should also be individually checked, adjusting them as may be necessary, an that the desired volume of air is passing through each and every grille. These should be provided with a locking device so that they can be locked in position after the system is once well balanced. By providing this locking arrangement passengers cannot tamper with these grilles and unbalance the entire system.

Grilles can be located in the floor of the cabin if it is impossible to locate them elsewhere. It is very undesirable, from the standpoint of cleanliness, to have grilles located in the floor, so wherever possible the system should be so arranged that this is not necessary.

The mushroom ventilators located under the seats are the best form of exhaust outlet which can be provided. These do not accumulate dirt and dust as do grilles in the floor, and can be made very light in weight.

In some planes it may prove more convenient to supply air through the cabin floor and exhaust through grilles in the ceiling. This also may be done by using the mushrooms under the seats for air inlets.

Either type of system, that is, either top supply and bottom exhaust, or bottom supply and top exhaust, can be designed to give equally satisfactory results. It is merely a question of which type of system will work in with the structure of the airplane in question, with the least weight.

Ventilation a real need

The Guggenheim Fund in a bulletin issued after an investigation of the causes of air-sickness, state that one of the principal contributing causes is lack of proper ventilation.

In a recent issue of an aeronautical magazine a man prominent in the aviation industry dwells to quite an extent on the fact that they must provide passenger comfort equal to that offered by the railroads if they are to compete successfully. He states that in some cases the weight of items installed solely for passenger comfort "included in the empty weight of the plane, reaches the astounding figure of 8 per cent of the plane's gross weight."

Thus it is apparent that manufacturers, and operators of airlines are beginning to realize the importance of passenger comfort.

Felt in aircraft

The matter of logical selection and application

By John F. Hardecker
Naval Aircraft Factory

HISTORICALLY, felt is one of the oldest of the recognized fabrics, as the art of felting preceded that of spinning and weaving. It is produced by the matting or "felting" of wool fibre. When it is desired to incorporate non-felting materials, such as cotton, wool must always be used to "carry" them.

In the manufacture of felt the raw materials are first thoroughly mixed and blended in a machine known as a "picker" from which they are conveyed pneumatically to the carding machines where the fibres are literally combed into order. From the card the wool is delivered in a thin layer onto an endless belt conveyor on which the felt is built up layer by layer to the required thickness. The material is then sprayed with water and passed through vibrating iron rollers which stir up the fibre and begin the interlocking process characteristic of felt. In the fulling operation which follows the fibres are pounded so that they become more or less completely interlocked. The felt is then dyed, dried and, if necessary, pressed.

If one were to list the various types and thicknesses of felt used in airplane construction one might readily gather that felt was one of the most technically specified and selected materials used. There is, of course, sound justification for reasonable diversification, but the multiplicity of types and thicknesses prevailing among different plane manufacturers for exactly similar purposes, raises the question as to whether some attempt at logical selection is not in order.

On aircraft of the open cockpit type perhaps the greatest use of felt is found in the installation of gas and oil tanks. Strips of commercial all-wool grade felt (S.A.E. Spec. F-12) should be used for this purpose. The material is ¼ in. thick and weighs approximately 2 lb. per sq.yd. If less expensive grades are to be substituted a felt of not less than 65 per cent wool (S.A.E. Spec. F-15) should be employed, for the cheaper grades have a tendency to split apart in cases where tanks must be removed for repair, whereas the better grades may be used over again in such cases without the necessity of replacement. Where tanks, or certain radiator designs are slung in position, a soft pad of felt of approximately 50 per cent wool content (S.A.E. Spec. F-26) is recommended, as the supporting straps then have a tendency to groove into the felt and make a permanently tight cushion.

Felt of 80 per cent wool content (S.A.E. Spec. F-13) 1 in. thick, weighing approximately 7½ lb. per sq.yd., covered with leather is often used around cockpit openings, and for crash pads. This is an improvement over horsehair padding as it can be laced to the fuselage and will remain in place. Crash pads should be built up to a thickness of 1½ to 2 in. and so located as to safeguard the pilot's head.

Felt in the engine

Felt is used for engine washers and gaskets for two principal reasons: (1) to prevent oil leakage and (2) to supply oil continuously to certain bearings. For both these applications an all wool white or grey felt (S.A.E. Spec. F-1 or S.A.E. Sper F-2) should be used, the actual selection depending upon the requirement. Felt of the piano variety is sometimes used for wicks in aircraft engines. For instrument board insulation a 65 per cent grey wool felt (S.A.E. Spec. F-15) ¼ in. thick, weighing approximately 1 lb. per sq.yd. will serve. Harder felt, of the piano hammer type, has some use as washers in the undercarriage in connection with springs or shock absorbers.

With the increasing demand for passenger comfort in cabin types of aircraft, the application of felted material for thermal and sound insulation has become more important. In many cases, the wall, floor and ceiling structure of the cabin has incorporated in it a layer of ¾ in. thick soft grade felt padding (S.A.E. Spec. F-60), weighing approximately 2½ lb. per sq.ft. One specialty manufacturer has placed on the market a panelling material consisting of a layer of all wool felt between two thicknesses of bakelite which is said to be unbreakable, fireproof and reasonably sound-proof.

Another common application in airplane cabins is the use of felt window panel strips. These strips will vary with each individual design, but a double groove channel felt (S.A.E. Spec. F-11) ¼ in. thick, weighing 1¼ lb. per sq.yd. has proven satisfactory.

Felt of aeronautical grade usually comes in widths of 72 in. It is most easily cut by an electrical knife, but sharp scissors or a sharp knife and a straight edge may be used satisfactorily. For fastening felt to other materials fish glues are commonly used. For fastening felt to wood the glue may be applied directly but, for mounting on steel, it is generally the practice to clean the steel, apply a coat of shellac and then apply the fish glue after the shellac is thoroughly dry. No particular precaution is needed in the storage of felt as there is little trouble from moths, and moisture does not affect the weight more than 1 or 2 per cent.

Flying Equipment

COMMERCIAL AUTOGIROS

FOR the first time since the introduction of the autogiro into this country, machines of this type have been placed on the market for private use. Numerous autogiros have been built and flown experimentally and one or two have been delivered for governmental use, but with the showing of the new machines at the recent Detroit Aircraft Show, Pitcairn Aircraft, Inc., of Willow Grove, Pa. is offering two types of autogiro for public sale.

Both models have the characteristics of the most recent experimental design in which fuselage, tail surfaces, landing gear and rotor pylon are of welded steel tube, and the fixed wings are of wood and fabric with upturned tips for lateral stability. The rotor is of all steel construction with fabric covering, and the individual blades are universally pivoted into the hub. A short mast on the hub carries a set of cables which prevent the blades striking the ground or parts of the tail or fuselage when at rest. The hub is mounted on ball bearings, and an internal expanding brake, controlled from the pilot's cockpit, is provided to stop the blade from rotating after landing. For starting purposes the rotor may be connected to the engine through an overrunning drive and clutch. This connection is disengaged from the pilot's cockpit after the rotor reaches normal take-off speed.

The landing gear is of exceptionally wide tread and incorporates low pressure shock absorbing tires as well as hydraulic shock struts. The wheels are equipped with anti-friction bearings and brake equipment is provided. A castering tail wheel is standard equipment. The control system is of conventional design, the elevator and stabilizer control being of the push-pull tube type, and the aileron and rudder control of the cable and pully design. Dual controls can be provided, with those in the front cockpit, readily disconnected without tools. The general specifications for the two commercial models may be tabulated as follows:

	Model PAA-1	Model PCA-2
Number of seats	2	3
Engine horsepower	125	300
Rotor diameter (feet)	37	45
Approximate disc area (sq. ft.)	1,075	1,300
Area each blade (sq. ft.)	28.8	38.8
Total rotor blade area (sq. ft.)	107.2	154.4
Area fixed wings (sq. ft.)	50	

THE VOUGHT EXECUTIVE

AN airplane of military lineage adopted to high speed transportation for business executives is now being offered by the Chance Vought Corporation of East Hartford, Conn., in the Model V-50 Corsair. The machine is an open-cockpit two-place type, but for those who prefer the protection of a cabin, a readily demountable enclosure can be furnished over both cockpits.

The general appearance and structure of this machine are similar to those of the well known Corsair developed primarily for the Navy. It is claimed that the performance is also equal to any of the military types. It is interesting to note that the so-called "vision" center section developed primarily for military reasons, has been included on the executive model.

THE NORTHROP BETA

CLOSELY akin to the Alpha in form, materials, and construction, the two-place, low wing monoplane Beta was shown for the first time at the Detroit Aircraft Show by the Northrop Aircraft Corporation of Burbank, Cal. Smaller than the Alpha in overall dimension, the Beta is designed to accommodate two persons in open cockpits. It is of metal construction throughout, the fuselage being of the monocoque type, and the wings of the same multi-cellular construction used in the Alpha where shear and torsional stresses are carried by the sheet metal skin. No corrugated material is used in any of the covering.

The use of an inverted in-line engine permits unusually good cowling around the nose and makes possible a fuselage approaching optimum streamline shape. Landing-gear wheels and struts are completely enclosed in streamlined housings extending upward into the lower surface of the wing. These factors, together with the use of a full cantilevered wing make the entire design about as aerodynamically clean as the present state of the art permits.

The engine fitted in the first model of the Beta was a Menasco Buccaneer of 160 hp, but this machine is also to be available with a Wasp Junior radial air-cooled engine of 300 hp. The general characteristics as furnished by the manufacturer are as follows:

Span	32 ft
Length overall	21 ft 8 in
Height	8 ft 1 in
Wheel tread	5 ft 6 in
Wing area (incl. ailerons)	137 sq. ft.
Weight empty	1,135 lb.
Gross weight	1,770 lb.
Wing loading	12.9 lb. per sq. ft.
Power loading	11.1 lb. per sq. ft.

The Vought Executive

The Northrop Beta

THE STOUT SKY CAR

A LITTLE over a year ago, Mr. William B. Stout, well-known engineer of the Ford Motor Company, in an article in AVIATION (April 5, 1930), deplored the tendency of aircraft designers to follow established precedent in layout or contruction. That he took his own advice to heart was evidenced by his showing at Detroit of the Sky Car, which, although it involves aerodynamic characteristics common to most airplanes today, yet in arrangement, construction and appeal is sufficiently radical to mark it as one of the outstanding airplanes of the Show.

Perhaps the most significant element of the design was the consideration given to the psychology of prospective purchasers. Heretofore the public has had to accept whatever the designer saw fit to produce and call an airplane, but in this case deliberate effort has been made from the beginning to produce a machine similar in appearance to something with which the public is already familiar,—the automobile—and every possible means has been employed to stress the resemblance. At rest the machine stands level on the ground with the pilot and passenger at about the same elevation at which they sit in the average automobile, and in so far as is possible, the controls and instruments follow automotive practice. Pedals, starter buttons, brake levers, etc., appear in their accustomed places, and floor, windows, and interior cabin fittings have a decidedly familiar look.

The Stout Sky Car

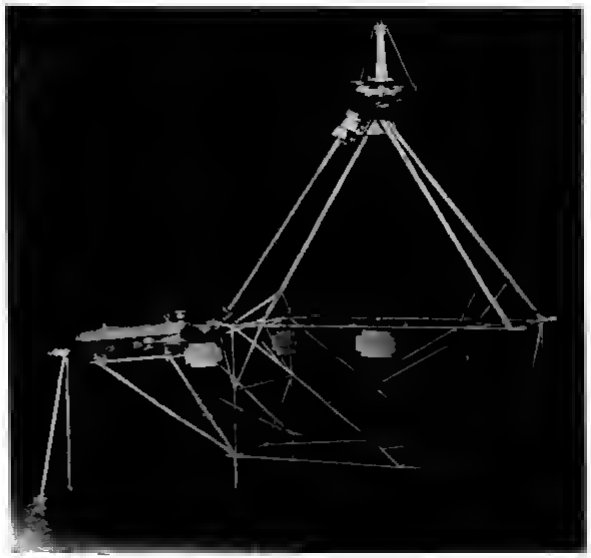
Aerodynamically the machine is a full cantilever, tapered wing monoplane with horizontal and vertical surfaces carried on three open booms at the rear. The stabilizer is of the Upson type in which the angle of the elevators to the fixed surface is varied at the neutral position, rather than by adjusting the angularity of the fixed surfaces to the fuselage. The control is from a knurled knob on top of the stick. The chief departure from conventional practice lies in the use of pivoted wing tip ailerons, similar to those employed on several well-known soaring gliders, rather than the more usual flap type.

The power plant, a 75-hp. inverted Rover air-cooled engine is mounted in the center section of the wing in the upper rear portion of the cabin nacelle and drives a pusher propeller. Cooling air for the engine enters through a scoop on the left hand side and is distributed around the cylinders through a series of ducts, leaving the cowling in the low pressure region immediately ahead of the propeller.

On the ground, the weight of the machine is carried by two air wheels supported on shock absorbing struts hung from the wing and located approximately in the plane of the center of gravity of the airplane. The machine is balanced by a retractable tail wheel, located at the rear of the cabin nacelle immediately below the propeller. This feature of the Sky Car was described and illustrated in the May issue of AVIATION. To prevent nosing over on the ground, a fourth wheel has been added under the nose.

The construction is all metal throughout and is similar to that of the well-known Ford transport. The wing and cabin are covered with flat and corrugated duralumin sheet.

Little in the way of detail with regard to general characteristics or performance is available at present.



Relation of the rotor hub to the engine in the Pitcairn Autogiro

OLYMPIC DUO-4 MONOPLANE

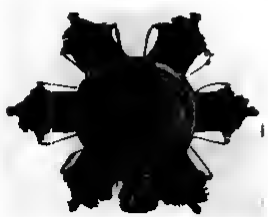
THE Olympic DUO-4 is a twin-engined cabin monoplane seating four or five persons including pilot and powered with two 125-hp Menasco C-4 engines mounted in a rather unusual manner. The engines, normally of inverted type, are laid on their sides and mounted in a wide, thin horizontal nacelle on the nose of the fuselage in such a way that the propeller disks are brought as closely together as is practicable. This mounting is believed to reduce head resistance very materially and to give the plane performance characteristics very nearly equal to those of an ordinary single engined plane of like power.

The landing gear of the Olympic differs from the Lockheed type in having the load strut carried to the forward wing spar and incorporating a shock absorbing unit with unusual length of travel.

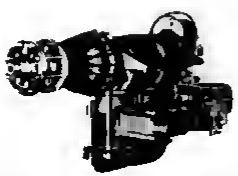
In wing and control surface construction the Olympic is of conventional wood type, plywood covered, but differs radically from any previous method of construction in the fuselage. The latter is of circular cross section except at the cabin, which is semi-circular on the bottom with straight sides to the wing in order to provide head room for passengers. It is built up from a combination frame work of steel tubing and wood over which is laid a plywood shell covering similar to the monocoque shell of a Lockheed airplane. In the Olympic, however, there is a continuous structure from engine mount to tail consisting of a very ingenious arrangement of hollow U-section steel tube members and rings to which laminated spruce rings and longerons are attached by wrapping, nailing and gluing.

Preliminary flight tests have shown the Olympic to be capable of maintaining level flight with full load on one engine at an altitude of 4 500 ft. above sea level. The manufacturer's specifications:

Span	42 ft.
Length overall	28 ft. 6 in.
Height overall	9 ft. 6 in.
Total wing area	270 sq.ft.
Cabin length	5 ft. 10 in.
Cabin displacement	157 cu.ft.
Baggage compartment	40 cu.ft.
Weight, empty	2,265 lb.
Useful load	1,355 lb.
Pay load	750 lb.
Gross weight, loaded	3,600 lb.
Wing loading	13 lb. per sq.ft.
Power loading	14 4 lb. per hp.



The 100-hp. Tiger



The 55-hp. Tiger Kitten

THE TIGER ENGINES

A PLAN to cover power plant requirements in the field of light aircraft by a series of engines of 20, 30, 50, 100, and 125 hp. is being developed by the Aeronautical Division of the Light Manufacturing and Foundry Company, Pottstown, Pa. The 20, 30 and 100 hp. models are now available and the others are ready to be put into production at an early date. All engines of the series will be air-cooled. The two larger models are four-stroke-cycle radials, and the smaller engines are in-line types, operating on the two-stroke cycle.

The largest engine now in production is the Tiger, Model 100, with six cylinders. A two-throw crankshaft and staggered cylinders make the engine virtually a tandem pair of three-cylinder engines built into a common crankcase. Pistons and crankcase are of aluminum alloy. The valve gear is the usual push rod and rocker type, with double springs provided at each valve. Zenith, Stromberg or Holley carburetors are optional equipment. Duel ignition is provided by either Bosch or Scintilla magnetoes. Full-forced feed lubrication to all bearings through a hollow crankshaft is provided. The engine is rated at 100 hp. at 1800 r.p.m. and weighs 278 lb. dry.

The smaller engines now available are known as the Tiger Kitten, Models 20, and 30. Both are of the same general design, being inverted two-cylinder in-line air cooled engines. The Model 30 carries a 2 : 1 gear reduction between crankshaft and propeller, whereas the Model 20 is for direct drive. Cylinder barrels are cast nickel iron with integral fins, and are bolted to the crankcase with long hold-down bolts passing through the head. The latter are of aluminum alloy, suitably finned for cooling.

Pistons and crankcase are also of aluminum alloy. Crankshafts are two-throw, one-piece forgings, and connecting rods are forged steel of I section, with roller bearings. Carburation and ignition are supplied from a single carburetor and a single magneto. Full-forced feed lubrication is provided. The Model 20 Kitten has a rating of 20 hp. at 2400 r.p.m., and the Model 30 is rated at 25 hp. at 3,000 crankshaft r.p.m., corresponding to 1500 r.p.m. at the propeller. The piston displacement in both cases is 77 cu.in.

Of the two models not yet in production the Tiger 125 is a seven-cylinder air-cooled radial engine, and the Model 50 Tiger Junior is a four-cylinder horizontal opposed air-cooled type, working on the two-stroke cycle.

APPROVED TYPE CERTIFICATES

DURING the period April 11 to May 9 the Aeronautics Branch of Department of Commerce issued the following Group I approved type certificates: 417, Overland Sports Trainer (Le Blond 5DE, 70 hp.); 418, Sikorsky S-41-A (two Hornet B, 575 hp.); 419, Bird CJ (Jacobs LA-1, 140 hp.); 420, Stinson SM-6000-B (1) and (2) (three Lycoming R-680, 215 hp.).

Aircraft at Work

Airplane bases for forest patrol

A BULLETIN recently issued by the San Francisco regional headquarters of the U. S. Forest Service points out that the use of aircraft in connection with forest patrol work often is extended beyond the simple duty of scouring for fires. According to S. B. Show, chief of the California region, airplanes are also being used for carrying messages, blankets, tools, and medical supplies to points where they are required. In one case fuel was urgently needed for a portable water pump operating on a large fire in Montana, and 10 gal. of gasoline were delivered by parachute within an hour from Spokane, Wash. The gasoline was carried in ten 1-gal. cans, each enclosed in a wooden box, wired together, and protected by a heavy buffer of paper.

Air bases for 1931 forest patrol service in the Pacific Coast district are located at Los Angeles, Palo Alto, Cal., Seattle, Spokane, and Wenatchee, Wash., Portland, Oregon, and Missoula, Mont. More than twenty airplanes are constantly engaged in forest patrol work in this area throughout the summer months.

Shipping furs by airplane

THE use of airplanes to transport pelts out of northern sections of Canada and Alaska has revolutionized the marketing of furs. Formerly the Eskimos were at the mercy of white traders who travelled from village to village and bought the pelts at comparatively low prices because the natives had no adequate means of transportation. Even then, the pelts were often so long en route that they reached the market in poor condition and the traders failed to reap the profits which the low purchase prices should have justified.

It has now become common practice for an Eskimo trapper to hire an airplane outright whenever he has accumulated enough pelts for a load. They are then flown directly to market, the Eskimo traveling with his cargo, often coming as far south as Edmonton, Alberta. The pelts arrive in better condition when carried by air—being in transit a shorter time. Rental for a plane for such a trip averages about $350. On one trip an Eskimo from Banks Land brought 1,100 white fox pelts to Herschel Island and sold them for $38 apiece, or a total of $41,800 for the load.

In some sections it is the trader who has adopted the airplane and by flying directly to the source of the pelts he is able to offer the Eskimo a much higher price than formerly, as he is enabled to make a quick turnover, and does not risk spoilage enroute.

Ice cream catering by airplane

DISTRIBUTING its products by airplane, the Chapman Ice Cream Company, a Los Angeles concern which specializes in unusual forms and flavors of ice cream has broadened its market materially. Formerly these special creams were available only to purchasers within a radius of available ground transportation, but recently a test shipment by air was made from Los Angeles to Dallas, Tex. The ice cream, packed in chemical refrigerants, arrived in perfect condition, and, as a result, several additional orders were placed from Dallas. Mr. A. A. Bomey, president of the company, reports that shipments are now being made in good condition where the time en route is as much as 24 hr. This company has inaugurated a merchandising campaign to attempt to establish a catering business over a wide area of the western half of the United States, and it is not impossible that within a relatively short time food products of this nature from the West Coast will be available in markets of the Eastern seaboard.

Shipping ice cream by plane

Fishing boat scouting by plane

GUY SILVA, one of the largest independent fishing boat operators on the Pacific Coast, has placed a Fleet biplane in service as an aid to locating schools of tuna fish. The machine is mounted on Edo pontoons and is equipped with short wave radio sending and receiving sets by which it communicates with the fishing boat. Use of the scouting plane is making it possible to catch a load of fish in less than half the ordinary required time. This permits the operator to take advantage of favorable market conditions as he can stay in port until the price for fish is favorable and then cruise out, catch a load, and be back in port ahead of competitors.

Desert prospecting

A GROUP of Arizona miners has organized a syndicate to prospect by air a portion of the Arizona desert located southwest of Ajo, Ariz., along the Arizona-Mexico border. This section is believed to be rich in minerals, but is extremely barren and arid, and it is impracticable for prospectors to stay in the area long at a time due to lack of water and transportation facilities. The time spent getting into and out of the district is out of proportion to that available for prospecting, and work progresses at a painfully slow rate. By the use of an airplane it is planned to "spot" several prospectors around through an area approximately 100 sq.mi. and to keep them supplied with food and water by airplane. Samples for assay can also be carried out quickly, thus speeding the recognition of likely ore deposits.

George A. Willson, B. M. Curry, and Miles M. Carpenter are the mining engineers backing the project. The pilot engaged for this work is John O. Chapin.

The Salesman's Notebook

Promotion by mail

PROMOTION of patronage of a particular airport or of a company operating on an airport—as well as conventional sales stimulation—through the direct-by-mail effort, may well become a more important competitive gesture than it is now. Wayne County (Detroit) Airport recently produced an excellent example of airport patronage promotion. Robertson Airplane Service Company at Lambert-St. Louis Airport, Robertson, Mo., is using similar means to advertise its service and facilities at that busy point, and Detroit Aircraft Corporation likewise in engaging in an interesting campaign.

The Wayne County letter, which might be profitably emulated by any progressive airport, was prompted by the anticipated presence in Detroit of scores of pilots attending the National Aircraft Show. Accommodations, characteristics of the landing area, transportation facilities to the city and general equipment—all items of deep interest to the visiting pilots—were described. On the back of the letter was an aerial photograph, slightly retouched to emphasize the runways, together with further details regarding the plant. The invitation to take full advantage of these facilities was so phrased as to create the pleasant impression which every business cherishes. Such a letter will undoubtedly add customers.

Robertson explained in detail what it has to offer transient pilots, as well as the pilots basing at the St. Louis Field. This service, of course, does not vary particularly from what companies all over the country may be offering, disregarding its individual proficiency. The point is that emphasis is given to its operations; it is good advertising.

A number of air and ground photographs of the field and buildings are supplemented by a line drawing as the field appears from the air, the Robertson buildings being made conspicuous by solid black shading and by arrows in red ink. The cluster of buildings which includes the restaurant, rest room, field manager's office, Department of Commerce inspector's office, and medical examiner, is outlined with a red broken line and likewise made conspicuous by a red arrow. This letter will attract customers, too.

Detroit Aircraft Corporation has sent to 5,000 corporation heads and executives in this country an attractive letter which includes a survey of the business use of aircraft. It is featured by an emphasis on the general theme of airplane use by corporation and business houses rather than the direct promotion of the D.A.C. line.

Among other things, it points out that approximately 300 concerns have bought airplanes for use in their business during the last three years, and that "flying for business is not expensive, when one considers the vast amounts spent to influence sales." The testimony of one user—the Prest-O-Lite Corporation—recommends the practice, and statistics indicate the vast increase in patronage of scheduled transportation in recent years, evidence of growing dependence on aircraft.

This is the first of a series of surveys or bulletins the company contemplates. Subsequent surveys will treat the reliability in flying for business, the work of the Department of Commerce in assisting aeronautical development, and the practical problems encountered in the business use of airplanes.

Airport Management

Controlling airport crowds

WORKING and landing areas devoid of all but authorized persons is a Utopia which every airport manager, or operator on an airport, would achieve. The Boston Municipal Airport layout approaches closely to the ideal, with one of the best methods yet devised for controlling airport crowds. It provides plenty of space for spectators and for parking automobiles, and keeps the effective landing area, the approaches to the hangars from the field, and the hangers themselves free of the uninvited.

Each building and the contiguous ground is an "island". Take a single hangar unit as an example. The runway is east and west, the hangar side walls are parallel with the runway and its doors open at the east and west ends. An iron picket fence extends north from the northeast corner about 50 ft., then is extended west a distance exceeding the length of the hangar by about 20 ft. Then the fence runs from the northwest corner due south to the fence which parallels the sidewalk and highway. Here there is a gate.

Crowds visiting the airport filter into this "island". The west doors are shut or, if opened, the entrance is roped off, and spectators pass north along the 20-ft. passageway between the building and the fence to the ample area north of the building. Since the fence joins the building at the northeast corner, the area in front of the open east door is entirely free for handling planes. Automobiles are parked across the street in large reserved areas.

Areas for controlling crowds at Boston Airport

Restaurant building at Los Angeles Airport. This structure houses banquet rooms, cafe, dining room, soda fountain, cigar counter, and living quarters for the airport manager and his wife.

Coffee shop at United Airport, Burbank, Cal., seating 24 at the half-square counter

Duplicate hangar and yard units are located at intervals of 100 ft. or so along the edge of the field. Thus from the east door of each hangar a 100-ft. passageway is provided to the field. There is a gate in the north fence of the spectators' area through which authorized persons—such as officials, guests and purchasers of passenger tickets—may pass directly to the field and to passenger planes.

In this way the visitor to the airport may see the servicing and overhaul operations through the open hangar doors and may penetrate to the flying field where he has an unobstructed view of flying operations. The average airport visitor is very curious about what is going on in, and immediately around, the hangar. This curiosity should be satisfied. If the hangars were built with the front door facing the field, the space directly in front of the doors and extending to the flying field would have to be roped off to permit easy access to the field and various ground operations. Though this would lessen the close contact between the public and ground phases of the activity, the above scheme, slightly revamped, could easily be adopted by many airports where the hangers are so arranged.

The same kind of an arrangement surrounds the administration building. Here lounging, eating, telephone, telegraph, information and other facilities are available. It is obvious that the airport takes seriously its accommodations for the general public, a point which all airports should have at heart because of the direct influence involved on the general aviation interest and the prosperity of the units operating thereon.

The Hub City as a hub of aviation

ADORNING one wall of the lobby in the administration building of the Boston Municipal Airport is a unique colored map of North and Central America, emphasizing Boston as a hub of aviation. The interest on the part of Boston in various forms of water and air transportation is symbolized pictorially by ships and aircraft of various types used down through history.

Restaurants and the airport

REPORTS on a number of California airport restaurants indicate that airport users there are provided with better than average eating facilities. The four busiest transport terminals have dining rooms or coffee shops, and in some cases lunch counters as well, while other leading centers have satisfactory lunch counters or coffee shops. Patronage in most cases is on the increase, specially by the general public, a direct response to quality food. Arrangements for banquets may be made.

The depot and administration building at United Airport, Burbank, has one of the best equipped places for eating at any Pacific Coast port. A coffee shop on the ground floor seats 24 guests at a counter, an adjoining dining and banquet room seats 150 guests normally, and as many as 200 comfortably for special occasions. The promenade balcony on the second floor of the building has dummy waiter service direct from the kitchen.

These facilities are operated as a concession under direct airport supervision, the operator paying the airport a percentage of his gross receipts. All equipment, except linen and silver service, was installed and is owned by the airport. An average of 5,500 customers patronize these facilities each month, about 40 per cent being airport personnel. Preparation and service of food is in every way equal to the first class restaurants of a city. Twelve employees are normally required.

Grand Central Air Terminal Glendale has another large and elaborate

Map in the lobby of the administration building of Boston Airport

coffee shop and dining room installation. The coffee shop, located on the ground floor of the depot building, seats 90 guests at buffet counters. An ornate dining room on the second floor normally seats 200, can accommodate many more on special occasions, and is equipped with a polished hardwood floor for dancing.

Both restaurant and coffee shop are operated by the Interstate Company under a ten-year lease. Rental is also on a percentage of gross business basis. It is estimated that 80 per cent of the business comes from personnel of the airport and the balance from the general public, including airline passengers. The banquet room is used frequently. There are sixteen employees.

The furniture and fixed equipment of the dining room and coffee shop were installed by the airport. All linen, silver, and miscellaneous kitchen and table equipment, where supplied by the Interstate Company. Food and service equal average city restaurants.

Eating facilities at Oakland Airport, include a first class lunch counter, located midway in the hangar line and operated by an individual, and a first class coffee shop and dining room, operated in connection with the hotel which is located next to the administration building and run by Interstate. These are operated on the basis of a base rental plue a percentage of gross income. The lunch counter has provan quite popular with the general public.

The coffee shop and dining room patronage comes largely from among airport personnel, many of whom five in the hotel. The coffee shop accommodates 60 at a buffet counter. More than 200 guests can be cared for comfortably in the main dining room, which is pleasingly decorated. It draws substantial patronage; many spertal parties are accommodated at luncheons, afternoon teas, and dinner functions.

Eating facilities on Los Angeles airport are housed in a separate building of attractive Spanish architecture, located on a line with the main hangar buildings. It also is leased on a commission basis to the Interstate Company. Restaurant and buffet counter are in a single room with a joint eashier. Approximately 36 can be seated at the counter and 120 at tables. A separate private banquet room accommodates 60. Special parties frequently use this.

Leased under a five-vear contract on a basis of $150 a month minimum rent or 10 per cent of gross receipts from all sales, the restaurant has exceeded the minimum rental regularly since the first three or four months of operations. Daily volume of business now averages from $55 to $100 per day throughout the year, with a much greater volume on days of apecial events. The restaurant serves meals and lunches, operates a soda fountain, sells tobacco and candy, and has recently added several novelties to its stock.

Design Novelties

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Curtiss-Wright Coupe monospar wing

THE outstanding structural characteristic of the recently announced Curtiss-Wright Coupe (AVIATION, April, 1931) is its novel wing design. The conventional two spar truss arrangement has been entirely replaced by a single built-up triangular girder occupying the leading edge of the wing from the nose back to approximately one-fifth of the chord. All stresses from rib, ailerons, landing gear, etc. are transmitted to the fuselage through the girder.

In designing a monospar wing of any type, the first consideration is the selection of a proper airfoil section. It is obvious that the difficulties in design would be greatly increased by the use of an airfoil whose center of pressure varies between wide limits. The section selected for the Coupe is known as the C R.-2 and has decided convex lower camber. It is reported that the maximum center of pressure travel is less than 4 per cent of the chord length. Under such conditions, the design of a single spar becomes practical.

In cross section the three main members of the girder form an isoceles triangle whose apex is at the leading edge and whose base lies in a plane perpendicular to the wing chord about 20 per cent of the way back from the nose. The two base members are made up of tubing of elliptical shape and are progressively reduced in section as the wing tips are approached. These beams are fastened together by diagonal tubing cross members. The beam in the leading edge is supported from the two other main members through a system of diagonal cantilever bracing tubes. All ribs and aileron hinge supports are cantilevered aft of the main girder. The aileron support, as well as all members of the girder, are of chrome molybdenum steel, welded together. Ribs, nose forming members, and leading edge are of plywood.

The monospar design permits not only a saving in weight of wing structure, but also in the landing gear, as the wheels are hung directly from the wing girder making unnecessary the usual extra struts to esrry the load to the fuselage. The attachment of the wing to the fuselage is also simplified as only one major bulkhead is required in the latter to take the greater portion of the load. Only one external adjustment strut is necessary to rig the wing.

Right: Detail sketch of the monospar wing of the Curtiss-Wright Coupe. Below the complete wing structure

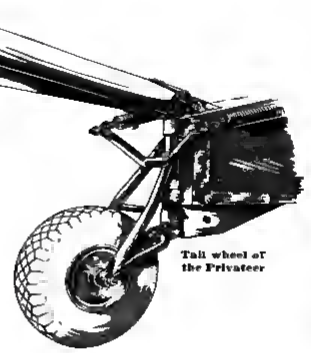
Framing of the Autogiro rotor

Construction of the Autogiro rotor

THE peculiar load conditions to which the rotor blades of the Autogiro are subjected impose a radically different type of construction from that of the ordinary airplane wing. Each blade is essentially an airfoil of relatively thin section and of very high aspect ratio. It must be very stiff structually to prevent undue deflection under load—a difficult problem, considering that the shallow section seriously restricts the spar depth and that weight must be kept at an absolute minimum on account of the high centrifugal forces involved.

The backbone of the rotor structure is a single round steel tube running the full length of each blade, to which the metal ribs are attached. The latter are symmetrical in plan and, except for a short section near the hub of the rotor, are of uniform chord. Attachment to the spar is made at a point about 25 per cent of the chord length from the leading edge. A formed stainless steel strip joins all the ribs along the trailing edge.

On account of the unusual problems involved it was found that the specifications for alloy steel tubing as promulgated by the Army Air Service furnished material unsuitable for use as rotor spers. Weight, straightness, cecentricity, and variation of outside diameter must hold to extraordinarily close limits, and it required extensive experimental work on the part of the Summerill Tubing Company and the Metallurgical Laboratories, Inc., in cooperation with the Pitcairn Aircraft, Inc., to produce satisfactory tubing for the purpose. Weight control was one of the most important problems to be considered as even a slight variation either in total weight of the spar, or in distribution of the weight may lead to serious unbalancing of the rotor system. It is reported that the steel tubes of specification suitable for use as rotor spars will be available to all manufacturers who are building Autogiros under license agreement with the Autogiro Company of America.



Tail wheel of the Privateer

Tail wheel for the Privateer

A STEERABLE tail wheel so located, as to be effective as a water rudder is part of the regular equipment of the latest model of the Privateer, two-place monoplane amphibion, produced by Amphibions, Inc., of Roosevelt Field, N. Y. The wheel is made up of a pair of aluminum alloy casting bolted together and mounts a regular 10x3 in low pressure pneumatic tire. It is carried in a welded steel framework pivoted to the stern post of the hull of the boat. No shock absorber, other than the tire is employed. The tiller arms are welded steel tubes, and connection is made to the air rudder system through suitable springs and cables. The whole assembly is simple and readily accessible for repair.

Cover for engine rocker box

TIME is saved and the use of screws or locking wires is eliminated in removing and replacing rocker box covers on the second series Continental Model A-70 radial aircraft engine by the use of a newly designened cover lock. Locking or unlocking the boxes is accomplished by turning a small lever, which actuates a flat spring-steel cam engaging in slots in two short cylindrical pins fixed in the cylinder head. With the lever in the lock position, the covers are said to be grease tight and not subject to loosening from engine vibration.

Technical Abstracts

RADIO RANGE AND AIRWAYS

APPLYING THE RADIO RANGE TO THE AIRWAYS, *Bureau of Standards Research Paper No. 155, by F. G. Kear and W. E. Jackson.*

THE original type of aural radio range, developed and experimentally installed at Hadley Field and Cleveland in 1927 and 1928, was highly successful from a theoretical point of view and amply justified its adoption for installation on airways. There were however four improvements to be achieved before their complete practicality could be put beyond the realms of doubt: (a) methods must be perfected to prevent interference between adjacent ranges, (b) the coarses outlined must be sharply defined to prevent deviation, (c) the emitted beams must be so modified so the beacon could be located at bends of an airway, and (d) it was necessary to develop a method by which more than one course could be served by one installation.

The first and second goals were rather simply achieved through a series of operating tests. As is commonly known, the two code signals emitted by the early beacons were International Morse for the letters a and n.

Tests were also run using *k* and *s*, *x* and *s*, *o* and *s*, and a later series using *d* and *u*, and *b* and *v*, different pairs for different beacons. None of these combinations seemed as satisfactory as the original pair, and a system has finally been adopted using the old forms of *a*

and *n* sent in distinctive groups from two to twelve in number. By counting the singals between intervals the different stations are easily distinguishable. Further differentiation is insured by allocating frequencies to neighboring ranges at least 12 kc. apart between the assigned limits of 285 and 350 kc., as it was found that a spread of 8 kc. was ample for sharp tuning.

The other difficulties have been surmounted only by recourse to the higher resches of the radio engineers art, and both objects have been achieved. In general, two methods are adopted depending on the particular characteristics of the routes to be served. ft has been found possible to bend the beam through the station by simply inserting a noninductive resistance in the link series with one of the goniometer primaries. This procedure is generally adopted when the courses emanate at angles between 45 deg. and 135 deg. When the courses make angles between 135 and 180 deg., a vertical antenna is caused to radiate in time phase with the radiation from the phantom loop antenna and the field intensity of the former double figure of eight pattern is distorted, thereby producing the desired result.

PREDICTING LANOING SPEEDS

AN INVESTIGATION OF AIRPLANE LANDING SPEEDS, *by Kenneth F. Ridley, N.A.C.A. Technical Note No. 349*

MEASURED landing speeds of a number of airplanes were compared with the speeds predicted from basic aerodynamic theory, to determine with what accuracy such predictions could be made.

The speeds at which several military biplanes landed were measured by the N.A.C.A. using synchronized recording flight instruments, namely, an air speed meter, an accelerometer to indicate the instant of impact, and a ground speed meter used as an air speed check, and to furnish wind speed data.

Measurements, made at Stanford University, for four monoplanes determined the ground speed from a photographic record of the rotation of the landing wheel, by the use of a motion-picture camera which operated at a known constant speed by measuring the wind speed and fixing the still air landing speed at the algebraic sum of these quantities.

It is known that npon approaching the ground there is a redoetion of the induced angle of attack of the wings of an airplane which may be calculated according to the multiplane theory of Prandtl. This produces an increase of lift curve slope and a reduction of induced drag; it is therefore equivalent to an increase in the aspect ratio. The first step in predicting the landing speed is the calculation of this effective aspect ratio which is representative of level flight just above the ground. The reduction of the induced angle of attack of a wing system upon approaching the ground is $\Delta \alpha_i = -\bar{s}\frac{C_L S}{\pi b^2}$, where $\Delta \alpha_i$ = the change of induced angle of attack in radians, b = maximum span in feet, and $\bar{s}$ = influence coefficient. For the monoplane, $\bar{s}$ is equal to a, the coefficient of mutually induced drag, for which a chart of values is given in the report. For the biplane $\bar{s}$ is given by the equation

$$\bar{s} = \frac{a_{1-1} + a_{2-2} + 2a_{1-2}}{4}$$

where a_{1-1} is the influence coefficient for a biplane composed of one of the wings of the biplane and its mirror image in the ground plane, a_{2-2} corresponds to a similar biplane composed of the other wing and its mage, and a_{1-2} refers to a biplane composed of one of the real wings and the mirror image of the other.

The above formulas, while theoretically applicable only to monoplanes and equal span biplanes having ideal lift distribution, may in practice be applied without appreciable error to all normal biplanes with the exception of the extreme sesquiplane types.

From the equation for the induced angle of attack of a monoplane $\alpha_i = \frac{C_L S}{\pi b^2}$, it may be deduced that the equivalent aspect ratio when near the ground is $R_e = \frac{R}{1-\bar{s}}$ and an analogous derivation for the biplane gives $R_e = \frac{R}{1-\bar{s}K}$ where R = aspect ratio of the real or equivalent monoplane, R_e = effective aspect ratio of real or equivalent monoplane near the ground, and K = Munk's biplane constant.

The second step in the prediction is to develop a curve of lift coefficient vs angle of attack for a wing of this aspect ratio. The curve is determined by means of the formula, $\alpha_a = \alpha_i + \frac{C_L}{\pi}\left(\frac{1}{R_e} - \frac{1}{R}\right)57.3$ using the results of sull scale (Variable Density Wind Tunnel) tests of the airfoil profile used in the airplane. In this formula α_a = angle of attack of airplane wing in degrees, α_i = angle of attack of airfoil model tested (degreas), R_i = aspect ratio of model tested, and R_e = effective aspect ratio of airplane wing (or that of equivalent monoplane).

The third and final step is to substitute the valuc of the lift coefficient corresponding to the angle of attack for a three-point landing in the formula $V = \sqrt{\frac{2W}{P C_L S}}$ where V = velocity in feet per second, W = weight of airplane in pounds, P = density of air in slugs per cubic feet, C_L = lift coefficient and S = wing area in square feet.

Comparison of the landing speeds predicted by this methnd with the measured values showed a maximum variation of 2½ m p h., and it was therefore concluded thet the method was satisfactory.

ON THE SUBJECT OF DOPING

AIRPLANE DOPES, DOPING, AND DOPE ROOM REQUIREMENTS, *by Gerald P. Young, Air Corps Information Circular No 655*

PREPARED at the direction of the Chief of the Air Corps to serve as a guide in securing the proper material and equipment for doping and finishing service airplanes, this circular will be found of value by commercial manufacturers as well as by military contractors.

While leaving the specific requirements for dopes and their application, to the Air Corps specifications, the composition of dopes in general is discussed and the purpose of each constitutent explained. The proper conditions for doping are described and suggestions given for securing them. It is recommended that the first two coats of dope be applied by brush, but for the remaining coats application with the spray gun has beeen found to be the most satisfactory method. A detailed discussion of the requirements for spray equipment will assist in seleeting suitable equipment. Suggestions are made for the care of the spray equipment, and a trouble chart is given to aid in eliminating common sources of trouble.

Under the heading of finishing metal snrfaces, the method of cleaning is given particular atiention, the sandblasting of ferrous parts and the washing of aluminum parts being recommended. For the priming coat the use of the nvernight-dry, oil-base, red oxide primer is recommended. Two coats of color over the primer is all that is required to give a satisfactory finish. The materials for metal finishes should all be from the same manufacturer.

The requirements and construction of dope rooms and spray booths, their exhaust systems and the proper precautions to be taken to avoid fire hazards form the latter part of the circular. Dope rooms should be isolated from other departments, and their construction should be as nearly fireproof as possible. An exhaust system capable of promptly removing all flammable vapors and residues should be provided, eare being taken that the airflow change direction as little as possible to avoid heavy deposits of residue. The discharge from the exhaust system should be to the open air in a location where it will not endanger property. Every precaution should be taken to eliminate the possibility of sparks around the booth or in the exhaust system, the exhaust fan and its motor being particular sources of danger in this respect.

Servicing Short Cuts

FUEL ANO OIL UNIT

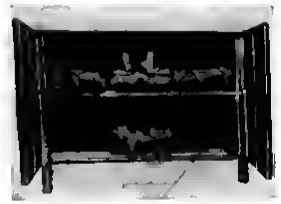
WITH airplanes coming in for servicing at the rate of one or two an hour throughout the day, coupled with the necessity of getting them back into the air in the shortest possible time, no available means of saving time and energy can be overlooked. One of the problems involved is to get gasoline and oil on board without delay. With the quantities which must be handled for their operations, the Ludington Lines at Washington found that the ordinary pit-type gasoline pumping units were entirely inadequate. The problem was solved by the installation of an electrically driven pump capable of delivering fuel to the wing tanks of the Stinson planes at the rate of 80 gal. per min. through a 1½-in. hose. The entire pumping unit is above ground and is located in the open air just outside the hangar on one corner of the servicing apron. Fuel is delivered through 75 ft. of flexible hose. Supply tanks are nnderground.

At the present time oil is delivered to each engine tank by means of hand pumps, mounted on portable oil drums. Plans are underway, however, to replace the hand pump by a compressed air system which will actually blow the lubricant in measured quantities from the containers to the engine tanks. Oil drainage is handled by means of a funnel, aod receiving drum mounted on a small dolly which is simply pushed into place below each engine dram plug in turn. Engine oil is now changed after every 20 hr. of service. At the moment no attempt is made to reclaim oil, but it is planned in the near future to install a suitable reclamation plant.

Ludington's gasoline pumping unit at Washington. Note that all parts are accessible foe repair or adjustment

PARACHUTES IN STORAGE

IN order to protect parachutes from the action of the salt air and dampness at the T. C. Ryan airport on San Diego Bay a closed parachute box was devised. The box is raised clear of the floor on short legs, and is divided into six compartments, each large enough for one paraebute, with ample space allowed for free circulation of air. Two ordinary carbon filament electric lamps, enclosed by metal guards to keep them from direct contact with the stored parachntes, are installed in the lower section of the box. The heat generated by the lights is sufficient to keep the air in the box dry and in circulation, aod thus keeps the contents in good condition. Air holes in the floor and between all compartments insure that the moisture driven off by the heat may be carried away.



Parachute storage cabinet at T. C. Ryan airport

STARTING POWER FOR THE SHOP

TO insure that battery equipment will be up to its full strength when planes are in actual use, the Alhambra shops of the Transcontinental and Western Airways, Inc. are using an auxiliary system for starting engines during the time that they are being serviced. This is accomplished by mounting storage batteries and a transformer unit on a hand truck which mey be moved from plane to plane. Most engines start directly from the battery current, but a few use a.c. for which current is supplied direct from a service outlet through the transformer.

PORTARLE RUN-IN STANOS

SEVERAL Pacific Coast engine overhaul stations have engine run-in stands on truck bodies in such a way that the unit is independent of any fixed plumbing or wiring and may be moved easily to any desired location. This equipment makes it possible to take an engine directly from a plane and transport it to a shop some distance away, or to take an overhauled engine from the shop and remove it to a more secluded spot for actual run-in. Engines may also be transported from one place to another with the minimum trouble or likelihood of damage. After run-in the engines may be trucked into shop where overhead crane facilities are available to assist in installation into the airplanes.

Portable engine run-in stand at Air Tech, Inc.

GERMANY'S AIR LAWS

DEUTSCHE LUFTFAHRTGESETZGEBUNG *by Dr. Alfred Wegerdt, Verlag Gebr. Radetzki, Berlin, 1930; M. 9.50.*

THE progressive development of aviation since the war created new legal problems which required adequate legislation. Nearly all important countries in the last decade not only subscribed to international conventions but enacted special legislation to deal with the new machine. Germany, no less than other countries, produced such legislation.

It has become traditional to expect thoroughness and comprehensiveness from a German. In Dr Wegerdt's recent book "German Air-Navigation Law" the tradition is fully maintained. The book is a logically arranged compilation of fundamental laws, statutes, enactments, decrees, treaties, conventions, etc. together with occasional annotations, all of which relate to German aviation from the inception of the German Republic until the end of July, 1930.

The principle of centralization is evident as one reads the air-commerce act. The work of the state and federal officials is coordinated. Regulations are uniform. The problems that we face in our country due to lack of uniform state legislation and divergence between state and federal standards in aviation do not appear to exist under the German law, although Germany is a federated republic.

Sections 19-30 inclusive of the German Air Commerce Act discuss in considerable detail the question of liability and damages arising out of accidents involving aircraft. The amount of damages an injured party may recover is limited. The statute also provides for indemnity bonds as part of owners of aircraft. It is significant that this legal phase is given special legislative attention. It is a recognition of the unique character of legal liability involved in aviation.

In our country, we have no such enactments, but rely on the principles of the common law to determine questions of liability and damages in aeronautical accidents. Naturally, a certain amount of injustice is bound to follow. Even in England, the home of the Common Law, there is legislation relating to torts resulting from aircraft.

No doubt Germany is as strong an advocate of the theory of national sovereignty applied to air space as are the other nations. This is fully expressed in the treaties with other countries. Apparently this theory is not extended to the states comprising the Reich. Federal authority is paramount. State officials are obliged to carry out the federal laws. Air navigation regulations are enforced intrastate as well as interstate. Conflict between federal and state jurisdiction appears to be non-existent.

Section 2 of the German Air Commerce Act gave Germany the opportunity of placing difficulties in the way of her former enemies in air navigation. Desiring to avoid the difficulties, the allied nations removed many of the burdensome restrictions contained in the Versailles Treaty, and thereby enabled Germany to develop aeronautically with rapid strides.

Dr. Wegerdt in a footnote explains the German attitude and justifies the action of Germany toward the former enemies on the theory of sovereign rights.

Excluded from the International Commission for Air Navigation, Germany was obliged to enter into separate treaties with the European countries for purposes of international air navigation. The full text of all these treaties is set forth. The provisions embodied therein are very similar to that of the CINA. Likewise, the air navigation regulations with few exceptions are similar to those internationally accepted.

The book is divided into seven major divisions, has a well-arranged table of contents, indices, and chapter headings.

To those interested in aviation this work is of considerable value, and we are indebted to Dr. Wegerdt for his comprehensive and logical compilation of a growing body of new law.—ELIAS GARTMAN.

GROUND COURSE INTRODUCTION

PREPARING FOR AVIATION, *by Lieut. Volney C. Finch, U.S.N. (retired), Simmons-Boardman Publishing Company, 458 pages, $4.*

ALTHOUGH this book is presented as an introductory text for senior high school, junior college and ground school aviation courses, it is so well written and so fundamentally sound that draftsmen, mechanics and all those associated in aeronautical activities, can profit by reading it. The book is conspicuously free from "padding," a fault often associated with elementary texts on aviation. It is refreshing to find it devoid of wordy descriptions of obsolete or antiquated constructions, practices or equipment, held over from earlier editions.

The subject matter includes: the principles of flight, materials, design and construction, maintenance and rigging, power plant selection, installation and maintenance; fuels and lubricants, propellers, seaplanes, flying boats and amphibions; autogiros; parachute maintenance; navigation; and airports. All the material is from recent sources, and the discussions represent current practice.

In conclusion, the book reflects a mature experience not only in matters aeronautical, but in their clear presentation to those contemplating the field for the first time. It is regretted that the line drawings utilized do not better reflect the fullest development of drafting technique, as their amateur appearance detracts from an otherwise excellent set-up.—JOHN F. HARDECKER, *Naval Aircraft Factory.*

A WAR PILOT GIVES ADVICE

Zoom, by George R. White, Longmans Green & Company, 182 pages, $1.50.

A CURIOUS book. It was intended, according to the foreword, to be a primer presenting fundamental facts regarding flying and aeronautics, based on the author's experiences. The book turns out to be elementary, but not in the way intended. Anecdotes, advice, examples, and flying precepts are thrown together in such an amateur fashion that the result is extremely amusing to anyone at all acquainted with aviation but not at all instructional. It is recommended to all experienced airmen for the laughs it unintentionally provides.—CHARLES H. GALE.

RADIO APPLIED TO AVIATION

AIRCRAFT RADIO, *by Byron F. Eddy, The Ronald Press, New York. 284 pages, $4.50.*

THIS is an excellent text or reference book on fundamentals of aircraft radio. The author bases the book on his years of experience as an instructor in naval and commercial ground schools and addresses it primarily to the average student encountered in those schools. It is valuable, too, of course to members of every branch of aviation as well as the layman.

Comprehensive though not exhaustive, it describes fundamental principles of electricity and of electricity as applied to radio, describes construction and function of the radio tube, the radio telegraph and radio-telephone set, and of various aids to aerial navigation (such as the radio ranga beacon), explains methods of installing radio aboard aircraft. Statutes and regulations pertaining to aircraft radio are also set forth.

Wire plans for various radio installations illustrate the text, which is written in a lucid and entertaining style. It is a very worth-while addition to any aeronautical library.—CHARLES H. GALE.

THREE BOOKS ON THE ELEMENTS

SKYCRAFT, *by Augustus Post, Oxford University Press, New York, 1930, $3.50.*

MR. POST and his publishers have achieved an extremely attractive book. Frankly designed for the youth of the country, it is beautifully printed and illustrated, and is written with a rare consistency of viewpoint and technical level. The author is particularly fortunate in his rich background of personal aeronautical experiences which have enabled him to enliven his descriptions.

The larger part of the volume is of course taken up by elementary principles and parts of the airplanes. It is possibly a little too thorough as it develops some of the more basic matters, such as the action of the controls. It is generally no more necessary to explain such things to a modern youth than it is to explain the steering of an automobile to the same audience. The chapters on the Parachute, Gliding and Soaring, the Free Balloon, the Dirigible, the Weather, and Airports, are especially acceptable.

The book closes with a chapter on the future which is one of the soundest I personally have yet encountered. It is a pleasure to learn that someone who has had 25 years of intimate contact with aeronautical developments can preserve a sane and technically supportable hope for more developments to come, and not fall into one of the extreme positions of hopeless grousing, or Gernsbackian futurizing, which are held by so many of us with a quarter or a half of his experience.

I would like to express a hope that Mr. Post might undertake a book, in which his background could be even more directly useful than it was in the present volume, such as a complete history of aviation from 1906 to 1914. A mere assembly of, and commentary, upon the photographs of pioneer flights and flyers which are decorated with his distinguished and distinguishing beard in the fore or background would be almost exhaustive for that period.

EVERYMAN'S BOOK OF FLYING, *by Orville H. Kneen, B.Sc., Frederick A. Stokes Company, New York. 1930.*

AFTER fifteen years or so of general engineering experience Mr. Kneen enrolled at the New York University school for ground school instructors. Convinced of a need for a textbook which might be used for the ordinary civilian, non-flying, ground school, or read by the type of person who might enroll in such a course, he has produced this volume.

A ground school of the above type presents one of the most difficult set-ups in the entire field of pedagogy. A huge subject, largely technical, delivered to a marvellously uneven audience containing everything from successful lawyers to problem children, and back again to cigar store salesmen with inventor complexes. I am afraid Mr. Kneen's book is more of a mirror, than a solution for the troubles of the university extender, and the teacher pilot.

The subjects treated historically in the book, and there are many, would form the nucleus of a pretty good history. The technical parts are sound, though the pega which explains plus, minus, and equal signs is a little elementary even for a ground school. The descriptive matter is extensive and has been industriously collected. It might well stand alone.

Nevertheless the combination of the parts is confusing and the inspirational matter which the author uses as his matrix rings a bit hollow in the present era of unemployment. The book abounds with such exhortations as: "Go aloft, young man, and grow up with the industry!" "We live in an epoch-making day that our children will envy." Yet they no doubt will travel six miles or more above the crowded traffic lanes of the earth. In air machines unbelievably large, they will speed through the upper stratosphere (sic) where neither storms, fog, nor ice will hinder their winged vehicles in the aerial age that is dawning."

And finally, may we not someday call a general halt on quoting poetry in aeronautical textbooks, especially poetry written before the era of airplanes by authors, who had something quite different in mind. Mr. Kneen opens his volume with some verses beginning, "Hurrah for the wings that never tire," and closes with Tennyson's "Locksley Hall." If this doesn't stop, I am going to write an article on wing ribs and work in verbatim the scene depicting the creation of woman from the Book of Genesis.—DANIEL SAYRE.

What Our Readers Say

More Power to the Light Plane

TO THE EDITOR:

The writer believes that all serious readers of AVIATION will congratulate Mr. E. P. Warner on his prophecy for the year. It certainly is a very logical analysis upon which to base the year's program. And if he is right, let us not forget.

The light plane has an excellent opportunity to fill its quota of 500, due to the fact that a foundation is gradually being provided for it to build upon,—light, reliable and low-priced engines.

Engines for this class should be of the unit type, with all the accessories self contained. The oil system should be built-in complete, carburetor mounted low, and a cockpit starter provided. This simplifies the installation and reduces to a minimum one of the greatest primary causes of powerplant failures, "poor plumbing." Reduce the plumbing to a single, simple, straight and a well engineered fuel line, and the result will be greater reliability and safety.

So much for the powerplant and now a few comments on lightplane design. Lightplane design requires the highest type of engineering skill and ability. Strength and rigidity must be designed into a light weight structure, to afford low flying speed, stability, and good visibility. These, in conjunction with a neat and artistic layout, will create a desire for ownership.

More power to the "flivver of the air."

A. WELLINGTON COOK
Engineer
Washington, D. C.

A Sale Lost

TO THE EDITOR:

Having done some little flying about ten years ago, it is only natural that I should be interested in this new industry, and have followed its footsteps closely through the pages of your magazine and others, as well as visiting air meets and shows whenever and wherever possible.

The different view points of men playing leading parts in the development of the industry, as set forth from time to time on the pages of AVIATION, have held my attention just as much as the technical developments, especially on account of their variance.

I would like to fly for pleasure with

a little business mixed in. I often drive my machine three or four hundred strenuous miles over crowded and dangerous highways to visit others in my line of business, and would greatly prefer to use a small, economical plane. Of course, during the past few months a number of small and practical planes have been developed and put on the market for less than $2,000, but the red tape necessary to leave the ground legally in your own ship is, in my mind, ridiculous. For any form of commercial work, the more strict the tests the better. I believe it was Mr. William Stout who suggested the use of simple types of training ships, and a system whereby anyone not blind or drunk could go in and lay down his ten or twenty dollars and get that much instruction without a lot of rigmarole.

A couple of years ago, a friend and I decided to purchase a plane jointly. We traveled several hundreds of miles to visit shows. We looked at various exhibits, and in some cases were even allowed to touch a plane without a re-buff, but in only one instance were we allowed to crawl into a cockpit to ascertain visibility and the other things you naturally want to know about a plane before you buy it. We were very much disgusted. There is no other word for it. My friend is a buyer for a large corporation and finally he said to me "I wonder if the people in this industry think the public is a bunch of saps, and are going to come up, look at a plane from a distance of ten yards, and then lay down a check for from three to ten thousand dollars."

And, as the saying goes "so we spent the hundred thousand dollars," but not on a plane. We bought a speed boat.

W. E. Walton,
Langhorne, Pa.

[Although it must be admitted that the situation described by Mr. Walton is still with us, there are certain rather definite signs that the exhibitors at shows are beginning to look at things in a slightly different light. Compare the opinions of some of the sales managers in their letters discussing the Detroit show published in Aviation for April 1931.—Ed.]

Build Airports With Highways

To the Editor:

Every state in the Union is building a network of fine roads. Airports, as everyone knows must be accessible, if the general public are to make frequent use of them. It seems quite possible to tie the two together. The state, at a minimum of expense, could purchase a wide strip of ground paralleling the right of way, and surface it at the time the highway was being built. Power lines are almost always present along such roads so the lighting problem would be simplified. Telephones would also be at hand. There are hundreds of stretches along these roads, where land is both cheap, and the grading of it a simple problem. There need be only one runway at each point as it could be arranged to have the next landing area on a curve of the road that would provide a different compass direction.

The cost of these areas would be little, if any, more than that of the road.

Alfred R. Fullerton, Jr.
Wood Ridge, N. J.

Training Planes

To the Editor:

Investigation of various aircraft presented for inspection might cause one to say, '*That* is a good training plane." And the listener might well ask, 'Why is that?"

How would you answer the question, "What are the qualifications and characteristics of a good training plane?" You will say, "Opinions differ."

But *why* do opinions differ? Quite possibly the answer to this question reveals the reason for the diversified aircraft now being offered to air schools for training purposes. Commercial schools either have not given this question a scientific analysis or because of their attempt to serve two masters, are using equipment not particularly suited for any specific purpose in an effort to pull additional revenue through their sales department.

The training division of the United States Air Service has made an exhaustive study of pilot training. Out of their fifteen years of experience has come an understanding of the problem of airplane selection. Their experience has not been duplicated or even approached by any commercial aviation school or any airaraft factory.

Naturally their statements of the requirements of an airplanc to be used for student training are universally accepted without question.

Recently the market was searched to find commercial aircraft that met *all* of the requirements for a training plane as enumerated in U. S. Army Specification No. X-1669, Dec. 12, 1929. Not one airplane on the market complied with *all* of the standards. True, some had load factors equal to Army standards and some had other characteristics of an approved type, but none came anywhera near meeting *all* requirements at once.

A careful persusal of this latest Army Training Plane Specification while checking over the design, construction and flight characteristics of a so-called training plane (selected at random) will result in some startling disclosnres.

Too often these airplanes have been advertised as "Built to Army Specifications." A check-up indicates that some one or two fcatures satisfying Army standards have been incorporated in the design, whereas all of the rest of the characteristics ara seriously out of line.

One manufacturer claimed for his product "Load factors to government specifications." Upon investigation it was found that with no equipment or accessories, with pilots weighing 170 lb. each the factors were actually 10, 6, and 4. However, the same airplane loaded with specification accessories and equipment and two pilots weighing 200 to each, as required by the Army barely satisfied Department of Commerce figures, which are respectively 7.15, 4.65, and 2.86.

Who is to blame for this situation? Certainly not the manufacturer. He has merely been trying to build an airplane that is a combination racing automobile, sport roadster, delivery truck and school car, at the commercial air school's instigation.

Training costs are admittedly high. In an effort to lower them, the school first complains about the initial investment and then demands that the ship submitted be a combination of all the varieties of airplane now known. As a result, airplanes are being used thet are hopelessly inadequate for efficient and economical training.

A combination racing automobile and delivery truck would not be expected to win in competition with cars built expressly for races. Nor does a car built with a box body make a comfortable pleasure vehicle.

Why then expect satisfactory results from an airplane that is a "jack of all trades?"

Manufacturing economies effected with a sacrifice in structural strength and ruggedness invariably inflict losses upon the purchaser through excessive maintenance costs far above the saving in list price.

One school operator paid six hundred dollars for parts, one hundred twenty-two dollars for flying expense, forty dollars pilot's pay and was forced to do without his airplane for twelve days, all in his first month of ownership due to inherent weakness of the landing gear members. Actually his attempt at economy was instead a costly sacrifice. His experience is not unique.

The obective of the Training Division of the U. S. Army is to secure efficient, accurate, thoroughly trained pilots at the least possible cost.

Experience has proven that better, more economical training can be accomplished in airplanes of certain definite specifications. Commercial schools would do well to profit by the Army's experience and demand that aircraft submitted meet with the requirements of A.S. Spec. X-1669 in its entirety. Time of instruction will be materially shortened, the efficiency of the graduated student will be increased, and the maintenance cost lowered considerably. It naturally follows that the school's appeal to new students will be enhanced, and profits certainly will be increased.

Eventually all commercial air schools will confine their training activities to ships especially designed for the purpose. When some air school's far-sighted executive adopts this policy, he will find aircraft manufacturers ready to meet his most exacting requirements.

K. R. Westover
Battle Creek, Michigan

The Buyer's Log Book

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Shielded spark plug

A NEW spark plug, built to the same general specifications as the B.G. plugs which have been standard equipment on many aircraft engines, but completely shielded against radio interference has been announced by the B.G. Corporation, 136 West 52nd Street, New York, N. Y. The plug is mica insulated, and has a standard core and hexagonal fittings so that it may be readily serviced with standard tools. Electrical connections are made through a threaded elbow terminal which can be assembled to shielding harness without the use of solder. This equipment is available for all types of aviation engines for any conditions of service.—Aviation, *June, 1931.*

Wrenches

ONE-THIRD less bulk and twice the strength, as compared with their old style wrenches in equal capacity is claimed for a new line of Crescent adjustable wrenches manufactured by the Crescent Tool Company of Jamestown, N. Y. These tools are the adjustable open-end variety and may be obtained in 6, 8 or 10-in. sizes.—Aviation, *June, 1931*

Lined tubing

OF PARTICULAR interest to manufacturers or users of solid type bearings should be a process for lining steel tubes with certain non-ferrous metal, recently announced by the Detroit Seamless Steel Tubing Company of Detroit, Mich. The lining materials are deposited centrifugally at elevated temperatures, and tests have shown that complete bonding of the two materials is secured. Practically all kinds of bearing material may be thus deposited in steel tubes in stock lengths up to 16 ft. This system offers an economic method of manufacture for standard sizes of steel backed bearings. Aside from the use as bearings, steel tubing may be lined with non-corrosive material for a wide variety of purposes.—Aviation, *June, 1931.*

Revolution counter

IT WOULD not seem illogical to compare the total life of aircraft engines on the basis of total number of revolutions, rather than total hours flown. An instrument for registering the full number of revolutions made by an engine has been marketed by Veeder-Root, Inc., of Hartford, Conn., in their recently announced "Rev-meter." The instrument is small in size and is permanently attached to the engine. It is geared to register one figora for each 10,000 crankshaft revolutions and will record over 9,000 hrs of normal use before repeating. Its weight ranges from 11 oz. to 1 lb. 8 oz., depending on the engine installation.—Aviation, *June, 1931.*

Coil and vibrator

A COMBINATION coil and vibrator to supply a continuous spark to the booster terminal on battery distributor, or magneto for starting has been placed on the market by the Delco Aviation Corporation. The unit is designed to operate with a 12 volt battery and weighs 13 oz. complete.—Aviation, *June, 1931.*

Light relay

OPERATION of aeronautical obstruction lights by a photoelectric cell and relay system is now offered by the General Electric Company. The CR7505-A2 photoelectric relay is a device which incorporates a photo-electric tube, a sensitive relay, a contactor and an amplifying tube. This equipment may be used wherever any important lights ara so located that they cannot be easily tended by personnel—Aviation, *June, 1931.*

Screw extractors

ONE of the most annoying things which must be faced by the mechanic is the removal of broken screws or studs. A useful set of drills and extractors for this purpose has been announced by the Greenfield Tap and Die Corporation of Greenfield, Mass. The extractors of various sizes may be purchased separately, and they are also supplied in sets.—Aviation, *June, 1931*

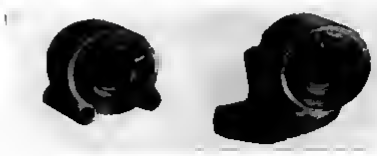
Switches

THE Delco Aviation Corporation of Dayton, Ohio, has recently announced two thermo-couple switches to be used in connection with engine temperature indicators on two- and three-engined planes. They are designated as A.F.-1001 and A.F.-1002, respectively. These switches are arranged for instrument board mounting, and weigh 6 oz. each.—Aviation, *June, 1931.*

Wheel finisher

TO SERVE the demand for wira wheels for the automotive and aircraft industry, the Ex-cell-O Aircraft & Tool Corporation of Detroit, Mich., has

The B.G. shielded spark plug



Veeder-Root "Rev-Meter"

Ex-cell-O wire wheel finishing machine

designed and placed on the market a semi-automatic machine for finishing wheels and brake drums. The machine is equipped for boring and turning to diameter, forming two peripheries and machining the hub face on wire wheels. It is full ball bearing equipped and is driven by electric motors contained in the base. The table is driven by means of spiral bevelled gears. All working parts are enclosed and the general construction of the machine makes for maximum rigidity. All control levers and starting buttons are conveniently located for the operator. Sixty-five to 70 wheels per hour can be handled by this machine.—AVIATION, *June, 1931*

Catalogs

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Reynolds Electric Company. Line flashers, signalling devices, and color hoods for electric lights are described in Bulletin No. 49, issued recently by the Reynolds Electric Company of 2650 West Congress Street, Chicago, Ill.

Young Radiator Company. Booklet No. H-1230, describing a complete line of unit heaters for building heating has been issued by the Young Radiator Company of Racine, Wis. Heating efficiency tabulation and installation diagrams are included.

The Taft-Peirce Manufacturing Company. A bulletin describing a number of gages and fixtures for tool makers and others engaged in work where great accuracy is essential, has been received from the Taft-Peirce Manufacturing Company of Woonsocket, R. I.

The Timken Roller Bearing Company. A publication which should be of interest to anyone having to do with selection of roller bearings for any purpose has been received from the Timken Roller Bearing Company of Canton, Ohio. It is in loose leaf form, and includes a great deal of information on the selection and installation of roller bearings, with detailed information on all styles and sizes of Timken bearings.

Crouse-Hinds Company. Bulletin No. 2218, describes a full line of threadless conduits, couplings and connectors for rigid conduit and electrical metallic tubing, manufactured by the Crouse-Hinds Company, Syracuse, N. Y.

Aircraft Radio Corporation. Bulletin B, entitled "Aircraft Radio Receiving Equipment" has been received from the Aircraft Radio Corporation, Boonton, N. J. This bulletin describes in full the line of Stromberg-Carlson radio receiving equipment for airplanes, and includes the general installation arrangements etc.

Side Slips

By ROBERT R. OSBORN

SOME of the new wild west airplane story magazines are unintentionally very funny. Mr. M.B.S. of Port Huron, Mich., apparently has been researching in that field lately, so we'll turn the platform over to him for a few moments.

"Our flying service being closed for the winter months and time hanging heavily on my hands I chanced to pick up one of these 'blood and thunder" aviation magazines. To say the least and certainly putting it very mildly, I was amused at the gross ignorance of the authors in regard to the actions of an airplane in flight. I am quoting a few examples in the hope that they might make choice reading for pilots and other persons having at least a faint idea as to how an airplane flies. Following are a few of the intricate maneuvers:

"'No; there was the field! But several tall pines stood before him and a clearing. Jim tried to bank slightly to avoid them but found that he lost altitude. So he had to take his chances. Just before he reached the fringe of higher trees, he pulled his stick back suddenly. The nose rose, clearing the trees. And before the plane could backslip, Jim pushed forward quickly on the stick, and the plane pancaked. A fish tail saved him from burying the prop in the ground. He found that the fish tail and the pancake had practically frozen his ship in space and it fell the remaining few feet to the ground, striking with all the sudden impact of a feather.' This was in reality quite a feat. The writer didn't mention the fact, but Jim must have had an ice pick concealed somewhere, otherwise I cannot understand how he got down to the ground after being all frozen up, so to speak. If Jim had used the small breakfast sausages and waffles with maple syrup I really believe he could have made a record for short landings at night. Personally fish tails would give me indigestion and pancakes are also heavy on the stomach and what with being frozen in the air I would much prefer the waffles and sausage. I would also like to be able to pancake a ship and land like a feather. Whenever one of my students pancakes the resulting bump is very much unlike that of a feather wafting gently to earth. I might add that any stalled landing that I have ever made was anything but feather-like. Here is a new idea in side slipping. 'His heart tightening as though with cold, Brad kicked left rudder and pushed his stick hard over to the left. *He side slipped for perhaps a thousand feet* sliding out of those funnels of flame that were slashing at his wings!" Somehow I do not believe in that method of side slipping! Maybe Brad was left handed, I don't know.

"The following extract takes the hand embroidered whiffle valve. 'Bing was maneuvering like a madman *** but he was limited in his movements by the fact that Jim wasn't strapped in the fore cockpit and too steep a bank would throw the boy out into space.' Maybe the high-flying author was thinking of an outside vertical bank or some other durn fool maneuver?

"Also here's a new way to do a falling leaf, '——it tumbled down through space like a dizzy bird (right, if they are speaking of the author) **** Jim clutched wildly at the safety belt *** and the monoplane tumbled over and over in a falling leaf!' For myself I would not care for this type of falling leaf unless the ship be furnished with one of those seats like they have on a ferris wheel."

Our Hangar Flying Department

An amusing story that has no parallel in the annals of aviation winged its way across seas recently. A plane had crashed at the Royal Air Force aerodrome, and the personnel rushed to the scene of the wreckage. First in the sprinting column was a level-headed airman, armed with wire cutters, who swiftly burrowed into the fuselage and proceeded to cut his way into the imprisoned crew of the luckless ship. Close at his heels was a medical officer attached to the staff of the aerodrome. He too carried the tools of his trade, and went into action without delay.

Seeing a man in the R.A.F. uniform apparently struggling to work clear of the wreck, the medical man selected a hypodermic syringe from his kit, thrust its sharp tip into the struggling man at the nearest spot, and administered a life-sized shot of dope to quiet his victims struggles, and to facilitate his rescue from the tangled web of wires and struts.

When the ambulance rushed away with its load of casualties of varying degrees, the onlookers, checking up, were mystified to find that the total exceeded the full complement of the plane's crew by one. History has not recorded the sensations of the R.A.F. wire cutter man, bent on his errand of mercy, when a burning sensation assailed him, nor his pungent remarks when he woke between the sheets of his hospital bed.—Contributed by Col. F.E.E., U.S.M.C., Washington, D. C.

TEXACO AIRPLANE OILS . . .

Modern concrete and steel building housing classrooms, shops and equipment of Roosevelt Aviation School, Inc., Mineola, N. Y.

THE CHOICE OF ROOSEVELT AVIATION SCHOOL

The most effective lubricant the market affords, a lubricant which would insure dependably perfect engine operation under every possible temperature condition at the lowest possible cost: was the demand of the trained pilots of the Roosevelt Aviation School at Mineola. And they chose Texaco Airplane Oils. For more than eight months Texaco Airplane Oils have been used at the Roosevelt School, one of the oldest and largest flying schools in the country and holding the highest Government rating.

● Ask any pilot who uses Texaco Airplane Oils what he thinks of their performance. He'll tell you the reason for Texaco success in the air—*perfect flying satisfaction.*

● Texaco Airplane Oils in four grades to suit every engine condition, with Texaco Aviation Gasoline and Texaco Marfak Grease, the unusual rocker-arm lubricant, are available at the principal airports of the country.

THE TEXAS COMPANY, 135 EAST 42nd STREET, NEW YORK CITY

RIGHT ON THE SIDE OF EVERY AIRWHEEL THE ANSWER TO CORRECT INFLATION

THE reason that Goodyear has put such amazing safety into Airwheels is the fact that these big soft rolling cushions operate at *low air pressure.*

That's why they can roll a plane safely over plowed ground—or sand—or snow—or mud.

That's why it is almost impossible to drag a wing in a ground loop—and why you can make a cross-wind landing.

Inflation, of course, is governed by the weight of the plane. And over-inflation makes these tires only a little safer than ordinary balloons.

But now—you can judge the inflation automatically. On every Airwheel there is a circumferential ridge of rubber—and you inflate the Airwheel until this inflation rib just touches the ground.

Only Goodyear can give you Airwheel safety, and the extra safeguard of the new roller-bearing Airwheel brake.

For engineering data, write or wire Aeronautics Department, Goodyear, Akron, Ohio, or Los Angeles, California.

When you buy a new ship specify Goodyear Airwheels

GOODYEAR

EVERYTHING IN RUBBER FOR THE AIRPLANE

Passengers boarding a Ludington plane. *The pilot receives last minute Teletypewriter instructions* *The dispatcher signals "All clear" and the plane leaves the ground*

ALL TRAFFIC AND OPERATING DETAILS OF THE LUDINGTON LINE ARE INSTANTLY TRANSMITTED BETWEEN AIRPORTS BY

TELETYPEWRITER SERVICE

Hourly flying schedules of the Ludington Line between New York and Washington call for eight planes in the air at the same time To operate the line at peak efficiency, Teletypewriters* connect the New York and Washington offices, and the airports at Newark, Camden (Philadelphia), Baltimore and Washington. These are used to transmit all administrative matters, instructions, dispatches, passenger reservations, accounting and auditing reports and, in fact, everything which has to do with operation

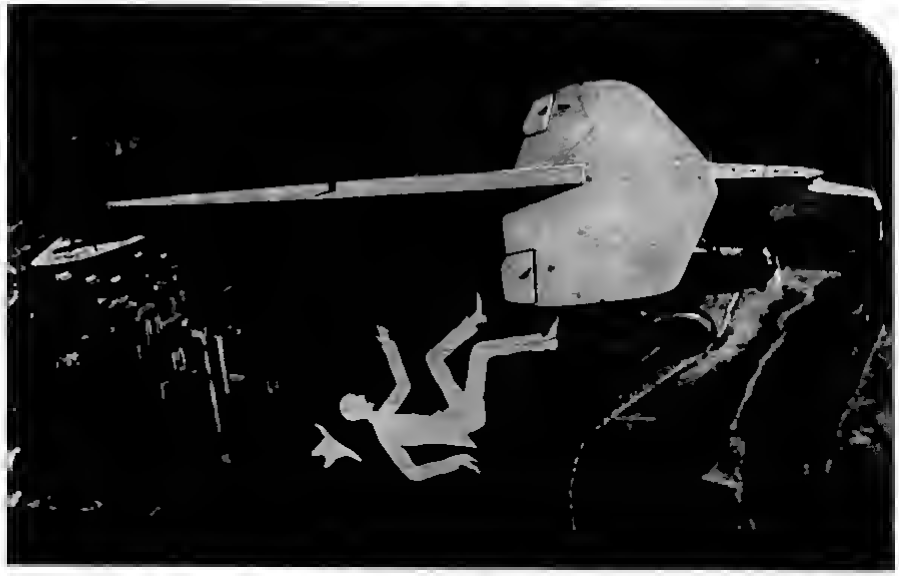
"I don't see how we could operate without the service," says Gene Vidal, Executive Vice-President "It would be too expensive otherwise. Take just one item passenger reservations. Teletypewriters enable us to adjust accurately our passenger space out of each city. They mean greater revenue, for we would lose passengers were we not able to work so quickly. And although hundreds of messages are exchanged each day between the connected points, no special operators are required."

Your local Bell Telephone Company will be glad to show you how Teletypewriters can serve *your* business equally well.

* * *

** Teletypewriters are machines resembling ordinary typewriters They are connected by Bell System wires so that a message typed on one is identically reproduced on the same instant by all other machines on the line.*

OUT WITH THE STOWAWAY!
THROW MR. WATER-THIN OUT OF YOUR PLANES!



MR. WATER-THIN costs you money every hour your planes fly. He means higher oil costs and higher maintenance costs.

For Mr. Water-thin is the quart or more of thin-bodied, waste oil that ordinary refining leaves in every gallon of oil. It vaporizes quickly. As a lubricant it isn't good enough—it's so light that Quaker State engineers have nicknamed it "water-thin."

And they've found a way to remove this waste. Every one of Quaker State's refineries—*the most modern in the world*—has special equipment that throws "water-thin" out. And Quaker State replaces it with full-bodied lubricant—giving you four full quarts of lubricant to the gallon, instead of three quarts and one of waste. So you really get an *extra quart* of lubricant!

And there's another reason why Quaker State is *good* for far more hours in the air. Every gallon of this great oil is made entirely from 100% pure Pennsylvania Grade Crude Oil. Quaker State is so free from impurities that it doesn't require acid treatment in refining. That's important! For acids tend to destroy some of an oil's oiliness.

Give Quaker State a test. You'll find it cuts oil costs and maintenance costs. *You'll know why in the space of a few short years popular demand has made it the world's largest selling Pennsylvania oil!*

QUAKER STATE
TRADE-MARKS REG. U.S. PAT. OFF.
MOTOR OIL

THERE'S AN EXTRA QUART OF LUBRICATION IN EVERY GALLON

Better Plane at Lower Price

STINSON $4995

F.O.B. F. WAYNE, MICH.

215 H. P. 4-Passenger Cabin Plane

Equipment other than standard extra

A complete revision in the solability of oirplones was caused obout o year ago ot the St. Louis Show, when for the first time in the history of this business, o cabin plone in the $11,000 price closs was offered to the public for $5775. This radicol departure was made possible only because of the Stinson Aircraft Corporation's offiliotion with the Cord group under the monogement of E. L. Cord. At that time Stinson openly odmitted that production did not worront the new low price. It wos their belief, however, thot public occeptonce would follaw. This belief wos vindicoted, os evidenced by Stinson's leadership in the cabin plone field. Last year Stinson built more than 50% of oll cabin plones built.

Agoin Stinson takes leadership! The 1931 Stinson program, with onother new rodically low price ond on improved plone, is a cantinuation of the policy which mode lost year so successful. Agoin, the monogement soys that the present volume does not worront the new price of $4995. But by putting on even better plone ot on even lower price within the reach of vastly more people, the Stinson monogement ogoin believes volume will follow.

It is Stinson's policy olways to moke cantinuol improvements but no radical chonges in design thot obsolete investments of Stinson owners. It is our belief thot the bosic design of the present Stinson plane will be continued for years to come.

OTHER STINSON PLANES• Four Passenger, 300 H. P. Wasp—$8,995 • Stinson Airliner Eleven Passenger Tri-Motored Transport—$25,900 • Eight Passenger, Tri-Motored Executive Model, prices upon request • All prices F. O. B. Wayne, Michigan. Equipment other than standard, extra. Prices subject to change without notice. Stinson Aircraft Corporation, Wayne, Michigan. • Division Cord Corporation.

POWERED BY LYCOMING

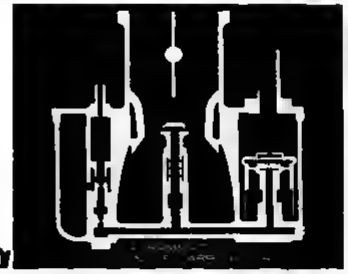
POWER

» » ALL WAYS

TAKE for instance, upside down flying. Naturally, the same forces that cause the pilot to be supported by his belt, cause the fuel to go to the top of the float chamber of the carburetor.

To prevent excess fuel going to the engine, Stromberg uses a check valve, incorporated in the needle valve seat. Stromberg Aircraft Carburetors function perfectly in the inverted position; the engine continues to run at full throttle. Fuel discharge nozzles, located in line laterally with the center of the float, keep the fuel flow from being disturbed.

When power is demanded from an engine equipped with a Stromberg, it is obtained . . . regardless of the maneuver or position of the plane.



Assurance of *power all ways* is just another Stromberg contribution to the advancement of flying. Stromberg's 22 years experience and research in carburetion is yours to command.

Over 95% of the Aircraft engines being built in the United States today are Stromberg equipped.

STROMBERG CARBURETORS

BENDIX STROMBERG CARBURETOR COMPANY

«SUBSIDIARY OF BENDIX AVIATION CORPORATION»

701 BENDIX DRIVE - SOUTH BEND, INDIANA

"Opened instantly from 75 ft. altitude —wonderful Safety demonstration"

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ACME—P & E

SWITLIK SAFETY CHUTES

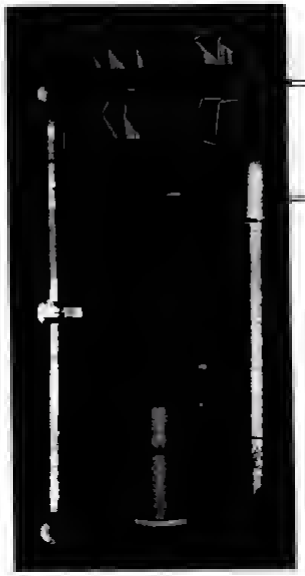
The above excerpt is from one of many letters we have received from prominent Aviation Officials, praising the Remarkable Performance of the SWITLIK SAFETY CHUTE. This parachute is the lightest, most compact and efficient parachute in the world today. It functions under all conditions due to its refined engineering. The snug-fitting harness is a revelation to wear, made of soft pure purged linen and held in a vest shape by the patented back pad and harness combination. SWITLIK is standard equipment for the foremost operating lines and flying schools everywhere.

White Silk
$300

Pongee Silk
$240

SWITLIK PARACHUTE & EQUIPMENT CO.
BROAD & DYE STREETS TRENTON, N. J.

WESTERN MANAGER — BERT WHITE — 1223 AIRWAY — GRAND CENTRAL AIR TERMINAL — GLENDALE, CALIF.



STANDARD THE SIOUX WORLD OVER

VALVE SEAT REAMERS for AEROPLANE MOTORS

Made for Precision Work

THE Sioux System of refacing valve seats in aeroplane motors makes it possible to obtain great accuracy with comparative ease and speed. The Sioux Aeroplane Reamer Set includes Sioux Pilot Stems, Feed Screw, Feed Screw Body, T Socket Handle, L. H. Aeroplane Reamers and Hammer.

The feed screw body has a spring within the feed, so that when the feed is screwed up it brings the reamer against the valve seat. The tension of the spring in connection with the feed keeps the reamer teeth beneath the surface of the metal. This adds much to the life of the reamer,—prevents the reamer from sliding over the glazed surface and thus avoids removing the cutting edge. The No. 1640 Feed Body is universal, so constructed that it automatically adjusts itself to every individual motor.

A cleverly designed pawl within the feed screw interlocks with a pawl on the pilot and thus eliminates the use of pins, set screws or threaded connections. Easily and quickly assembled.

Sioux Aeroplane Reamers are made of a special alloy tool steel which stands up and holds its cutting edge in the severe work of cutting the bronze valve seats used on most aeroplane motors. They are also made left handed so the tool can be turned to the right. Cutting resistance has been reduced by eliminating some of the cutting edges. Made in 45° finishing and roughing, 15° narrowing in finishing type and 75° narrowing in finishing type.

No. 1650 Sioux Aeroplane Reamer Set, Net, Complete $64.25

Your Jobber Sells Them

ALBERTSON & CO. INC.,
SIOUX CITY, IOWA, U.S.A.

WHAT THE 5 LEADING TRANSPORT SYSTEMS HAVE FOUND OUT ABOUT ENGINES . . .

Men responsible for building up the business of the great air transport systems have a keen appreciation of the importance of dependability. Particularly in engines. And in their flight reports and maintenance records the men who buy air transport equipment may read the story of engine reliability written with scientific candor.

In view of these facts, the figures on the engine equipment of mail-passenger planes on the five largest air transport systems in the United States are interesting. Of all of these engines in the air-cooled class, over 400 H. P., *99.6% are of Pratt & Whitney manufacture.* And 76.3% of all of the air-cooled engines in service on these planes are Pratt & Whitney products.

In military and private flying "Wasp" and "Hornet" engines are maintaining that same tradition of dependability. Wherever unfailing power counts most, these engines justify the complete confidence of pilots, designers and operation executives.

ENGINE CENSUS

A study of the engine equipment of planes carrying both passengers and mail on the five largest air transport systems in the United States brings out these impressive figures:

94.5% of the engines are air-cooled.

76.5% of the air-cooled engines are over 400 h.p.

99.6% of the air-cooled engines over 400 h.p. bear the Pratt & Whitney seal.

76.3% of all of the air-cooled engines are Pratt & Whitney products.

72.0% of all of the engines are Pratt & Whitney products.

Wasp & Hornet *Engines*

® REGISTERED TRADE-MARK

THE PRATT & WHITNEY AIRCRAFT CO.
EAST HARTFORD . . . CONNECTICUT
Division of United Aircraft & Transport Corp.

Manufactured in Canada by Canadian Pratt & Whitney Aircraft Co., Ltd., Longueuil, Quebec; in Continental Europe by Bavarian Motor Works, Munich; in Japan by Nakajima Aircraft Works, Tokyo.

"Increases payload"

Says senior air mail pilot, about Western Electric Radio Telephone

The Western Electric radio telephone is contributing to the successful operation of these airlines—

AMERICAN AIRWAYS INC.
Canadian Colonial Airways
Colonial Air Transport
Colonial Western Airways
Embry-Riddle Company
Interstate Airlines
Southern Air Fast Express
Universal Air Lines

NATIONAL PARKS AIRWAYS

UNITED AIRCRAFT AND TRANSPORT
Boeing Air Transport
National Air Transport
Pacific Air Transport
Varney Air Lines

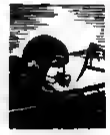
WESTERN AIR EXPRESS

TRANSCONTINENTAL & WESTERN AIR

NORTHWEST AIRWAYS

"The Western Electric radio telephone increases the payload of mail, passenger and express planes by reducing the amount of excess gasoline formerly carried to give the pilot ample cruising radius when he was uncertain as to weather."

So says E. Hamilton Lee of Boeing—airmail pilot since 1918—who has flown more miles than any other man alive. He cites this as one more reason, in addition to dependability and safety, why leading airlines equip with Western Electric.

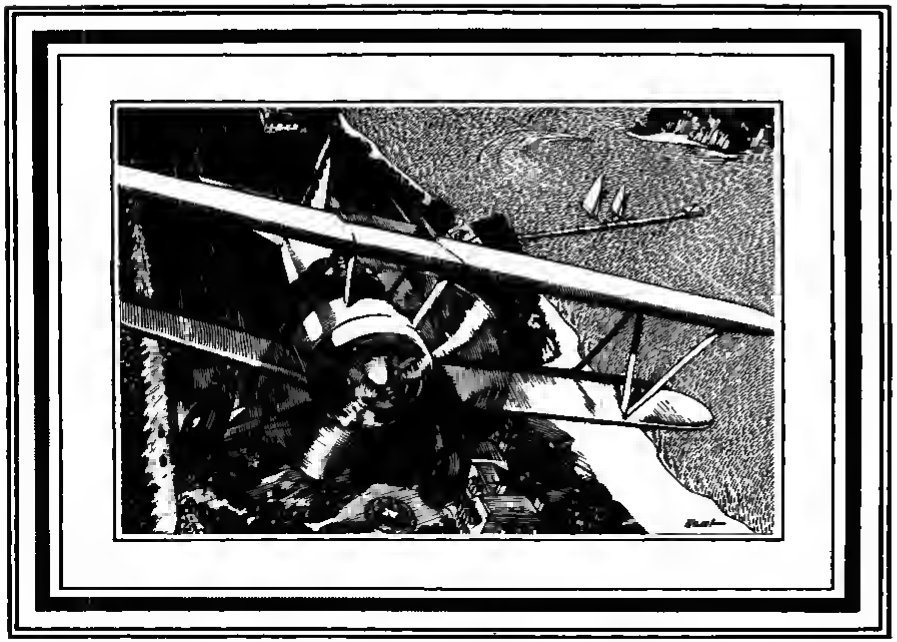


Private plane owners are likewise standardizing on Western Electric weather and beacon receivers. For full details, write to Western Electric Company, Dept. 257A, 195 Broadway, N. Y.

Western Electric
Aviation Communication Systems

MADE BY THE MAKERS OF BELL TELEPHONES

*Northern Electric in Canada



Peace of mind and *lower cost per hour* . . . PENNZOIL

One user of Pennzoil Aircraft Oils has flown four and a half million miles without accident or any engine failure that can be traced to lubrication. Here Pennzoil has brought peace of mind to pilots, ground men and officials all over the line.

Pennzoil is economical to use. It increases the period between overhauls. It gives you many extra hours with every refill. It costs less per flying hour. . . . For dependability, for economy, fill with Pennzoil.

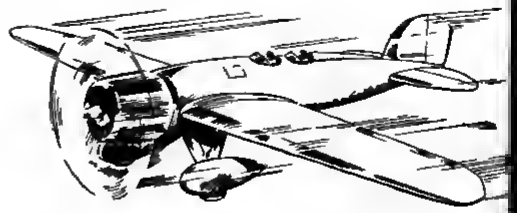
Ask for PENNZOIL—
Not just "Pennsylvania Oil"

The PENNZOIL COMPANY: Executive Offices and Refinery: Oil City, Pa.
Division Offices: New York, Chicago, Los Angeles
British-American Oil Co., Ltd., Sole Distributors in Ontario and Quebec, Canada

100% PURE PENNSYLVANIA
PENNZOIL
SAFE LUBRICATION

PENNZOIL is made by the famous Pennzoil Process from 100% pure Pennsylvania crude and nothing else.

PERMIT NO. 2—PENNSYLVANIA GRADE CRUDE OIL ASS'N



Heat-treated NICKEL ALLOY STEEL *engine parts make airplane engines* SAFER!

IN the production of aeronautical parts every precaution must be taken to assure safe and reliable performance when completed and put into service.

Expert forging practice, such as that employed by The Canton Drop Forging & Manufacturing Company, assures the ideal grain flow in the direction of the stresses to be borne, thus providing maximum resistance to such stresses.

Special heat treatments, carefully controlled, assure the ideal microstructure and the optimum mechanical properties obtainable in the material.

And Nickel Alloy Steels provide high impact and fatigue strength, and the necessary toughness to stand the gaff in modern flying service. Which is why these steels are used for the vast majority of forged parts in leading makes of aircraft engines.

Dependable materials are the best assurance of dependable performance

NICKEL

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.
Miners, refiners and rollers of Nickel . . . Sole producers of Monel Metal

Send for new Directory of Aircraft Engine Manufacturers

Nickel
ALLOY STEEL
PERFORMS BETTER LONGER

Etched section of Nickel Alloy Steel crankshaft (front — for radial engine, forged by THE CANTON DROP FORGING & MANUFACTURING COMPANY, Canton, Ohio. Note lines showing direction of grain orientation, indicating correct forging methods.

That enthusiasm for QUALITY which spells SATISFACTION

Exacting inspections of woods, thoraugh croftsmanship in manufacture, these are habituol in the moking of Paragan Propellers—not simply for their own sake, but to produce utmost satisfactian and economy in actual use. ¶ Back of these good habits is Paragan design; based an lang experience; authoritative. ¶ On smoller ships to sell at popular prices, an larger ships with geared engines—use Paragan Propellers; for lightest weight, for lowest cost. You'll find it worth while to consult with Porogan engineers.

AMERICAN PROPELLER COMPANY, SOUTH BEND, INDIANA

(Subsidiory of Bendix Aviation Corporation)

DISTRIBUTORS

Air-Associates, Inc., Roosevelt Field, Long Island, N. Y. and Municipal Airport, Chicago, Ill.
Bredauw-Hilliard, Municipal Airport, Kansas City, Mo.
Eastern Aircraft Supply Company, Bradford, Pa.
Becker Flying Service, Municipal Airport, Buffalo, New York
Aviation Sales & Service Corp., Minneapolis, Minn.
Trad Avon Flying Service, Easton, Maryland.

OVER NIGHT!

MODERN transportation has put Kansas City practically in overnight touch with its vital market of 21 million people, 19 million of whom are served more economically from Kansas City than from any other metropolis.

Twelve trunk line railroads and thirty-two subsidiaries speed passengers and freight to every section of this territory. Air traffic increases steadily to every point of the compass from Kansas City. Air mail now is delivered overnight between Kansas City and New York, Kansas City and Los Angeles. Bus and truck lines spread in a network from Kansas City to all points of travel.

And to complete this unusual transportation picture, barges soon will be operating on the Missouri River from Kansas City to all inland waterway cities and for export.

Kansas City has many industrial advantages that are described in the lately revised Book of Kansas City Facts. It is a complete picture of the city and its market, and should be in the hands of every important business executive. A copy may be had, without obligation, for the asking.

INDUSTRIAL COMMITTEE OF THE CHAMBER OF COMMERCE

KANSAS CITY, MO.

Industrial Committee, Chamber of Commerce,
Kansas City, Mo.:

Please send me the Book of Kansas City Facts. I am interested in the

_____ industry.

Name _____

Firm _____

Address _____

City _____ State _____

(I saw your advertisement in Aviation)

Photo by R. I. Nesmith and Associates

NOW

Give 'er the gun with SOCONY!

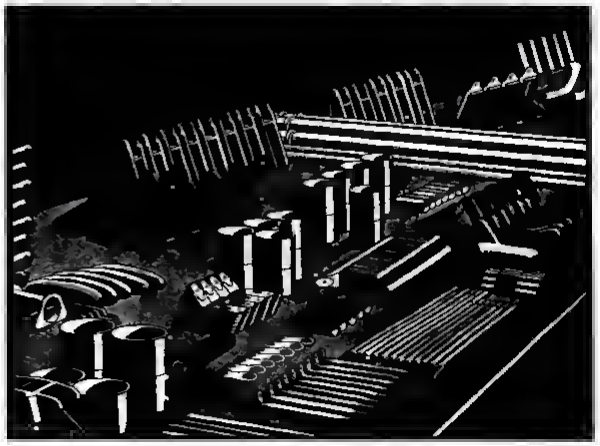
IN the air . . . ready to climb . . . *When she's powered with Socony Aviation Gasoline and lubricated with the New Socony Motor Oil,* you can slap the throttle open—and climb with never a sputter!

Use this air-tailored combination next time . . . You'll soon see why Socony is the choice of the majority of pilots in New York and New England.

SOCONY

Socony Aviation Gasoline New Socony Motor Oil

STANDARD OIL COMPANY OF NEW YORK



BUILDING STAMINA INTO CHANCE VOUGHT AIRPLANES

Until a seaplane has to be set down in a rough sea, a pontoon strut fitting is just one of a thousand details. But at the instant of landing, that fitting is either a perfect part or a real menace. There can be no compromise between the two. And so with every one of the hundreds of parts in a reliable airplane. Only by careful selection of materials, by accurate control in fabrication, thorough and frequent inspection . . . all backed by proper design . . . . can such perfection be attained. And every part in a Chance Vought plane is made and tested by that formula.

In the sunlit Vought plant, presses punch out the parts from which built-up fittings are made. Vought-trained mechanics do the welding and brazing. And Vought-trained inspectors watch the work. At every step, each part is subjected to careful check. None but perfect parts get through the many inspections.

All parts in Vought airplanes are designed and built for strenuous service. Vought planes in the Navy take catapult launching and deck landing into arresting gear as all in the day's work, year in and year out. And for sport and business, it's hard to find a faster, sturdier and more reliable ship. Chance Vought Corporation, East Hartford, Connecticut. Division of United Aircraft & Transport Corporation.

CHANCE VOUGHT CORPORATION

POSTAL TELEGRAPH SERVICE...FROM EVERY PLANE!

Every plane becomes a Postal Telegraph station . . . when Postal telegraph blanks are available on board and the plane crew is instructed to file passengers' messages at scheduled stops en route.

●

The flying public... the "top-layer" of traveling America... these are the people who travel fastest ...the people who make decisions... and write messages... en route. Naturally, they demand every facility for fast service in transmitting their messages, too!

Why not give them this service by making every plane a Postal Telegraph station... especially when it entails absolutely no cost to the air transport company!...There's nothing simpler. It's only necessary to supply Postal Telegraph blanks and instruct the plane crew to file passengers' messages at landing points.

The passenger writes the message at his leisure ...and a member of the plane crew files it at the next stop...There's no fuss...no bother...no delay. Passengers like it. It's a *courteous, extra* service that builds good will.

Start planning this service today. Wire Postal Telegraph Headquarters in New York City collect, and a Postal Telegraph Representative will call and tell you more about it.

• • •

Postal Telegraph is the only American telegraph company that offers a world-wide service of coordinated record communications under a single management. Through the great International System of which Postal Telegraph is a part, it reaches Europe, Asia, The Orient over Commercial Cables, Central America, South America and the West Indies over All America Cables, and ships at sea via Mackay Radio.

THE INTERNATIONAL SYSTEM

Postal Telegraph

Commercial Cables — *All America Cables* — *Mackay Radio*

SIGHTSEERS PAY PROFITS

More people are air-minded than ever before. Just about everyone wants to go up in the air.

This urge can be turned into handsome profits by the airport — by the airport that has the ideal ship for sightseers — the Fokker Super-Universal.

This famous plane thrives on the ups and downs and abuse of short hops. It is economical to operate, speedy and durable.

There are six passenger seats and baggage or lavatory room. Pratt & Whitney 425 h. p. "Wasp" engine.

The same traits that make the Super-Universal so perfectly suited to sightseeing trips, cause this ship to show pleasing profits in feeder lines, charter and taxi work at airports.

A Few Genuine Bargains

We have available at very low prices a few Super-Universals and other Fokker planes that have been used as demonstrators, as follows:—

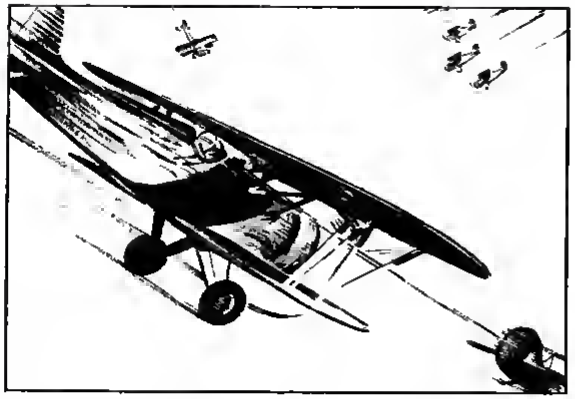
SUPER-UNIVERSAL	F-14A MAIL PLANE
STANDARD UNIVERSAL	F-10A TRIMOTOR

These airplanes are in fine mechanical condition, new-looking and fully guaranteed by us. There aren't many of them but they offer unusual opportunities for profits this summer.

• FOKKER •

AFFILIATED WITH GENERAL MOTORS CORPORATION

FOKKER AIRCRAFT CORPORATION OF AMERICA, GENERAL MOTORS BUILDING, NEW YORK



Here's the NEW NAME

COMBAT

Richfield's Aviation GASOLINE

RICHFIELD Aviation Gasoline now has a new name —COMBAT! The *"Fightin'est"* gasoline ever put in a motor!

It has new quality, too. Recent refinements in manufacturing plus carefully selected crudes—have produced a gasoline that surpasses "fighting grade" specifications as well as the most rigid requirements of commercial flying.

Here are some of the features:

High octane number, high knock rating, low vapor pressure, unvarying uniformity, freedom from sulphur, corrosive matter and gum—

You get all these qualities in this super-aviation gasoline that sells at the same price as ordinary gasoline. COMBAT Richfield Aviation Gasoline is available at leading airports both east and west of tha Mississippi.

Combat Richfield Aviation Oil, Combat Richfield Rocker Arm Grease, Combat Richfield Push Rod Grease—are other Richfield Aviation Products carrying the COMBAT name . . . and built to a higher standard of quality. Always ask for them.

RICHFIELD OIL COMPANY
LOS ANGELES • • NEW YORK CITY

1931 GREAT LAKES SPORT TRAINER

$2985
Flyaway
Factory

More than Ever....
The First Buy in Aviation

LOOK OVER the entire Aircraft industry . . . as so many thousands did at the Detroit National Show . . . and the 1931 Great Lakes Sport Trainer will have the most appeal for you in both value and performance. ■ Check it for beauty of line, stability and stamina, speed and maneuverability, design and engineering, quality of material and skill of workmanship. At $2985, it creates a class of its own! And it is now made in two models, with the engine inverted or upright as you prefer. ■ The fact-picture of the Sport Trainer, as Great Lakes builds it, should be in your hands today. Write for it the very next thing you do. ■ DEALERS find the Great Lakes proposition a sound and economic plan for building a real airplane business. With the Great Lakes franchise still open in many localities, be sure you send for the complete operating plan at once.

GREAT LAKES AIRCRAFT
CORPORATION CLEVELAND
Contractors to the United States Army and Navy

A SENSE OF SECURITY
is an added comfort

The luxurious interiors of planes, their Pullman-like appointments and the application of every known safety device have all contributed their share to the ever-increasing popularity of air travel in this country.

But crowd-control at landing fields is just as important as a safety factor. If crack pilots are unnerved by a crowded field, what feelings must the unexperienced air-traveler suffer.

Many transport operators have solved this problem by enclosing the promenades and parking areas with Anchor Fences, thereby insuring a clear field for landing planes. An Anchor Fenced field sighted by a passenger gives him a sense of security, which is truly a real added comfort.

An Anchor Fence doing crowd-control duty during the landing of Coste's plane

ON THE LINE

NOT OFTEN does the National Air Transport assemble its fleet of Ford tri-motored, all-metal planes, because, like a railroad, the "rolling stock" must keep moving. Every hour day and night an N. A. T. plane is humming through the skies on its scheduled way, carrying cargo of passengers, mail or express.

The fleet of fourteen-passenger transports is pictured here about to take its place with the famous fliers of the United Air Lines, of which National Air Transport is one of the most active divisions. You can properly imagine each of these perfectly groomed machines taking off to a different destination over established lines, guided by electric beacons, controlled from point to point by radio telegraph and telephone.

Their goals might be: New York . . . Dallas . . . Toledo . . . Fort Worth . . . Cleveland . . . Tulsa . . . Chicago . . . Maline . . . Kansas City . . . Oklahoma.

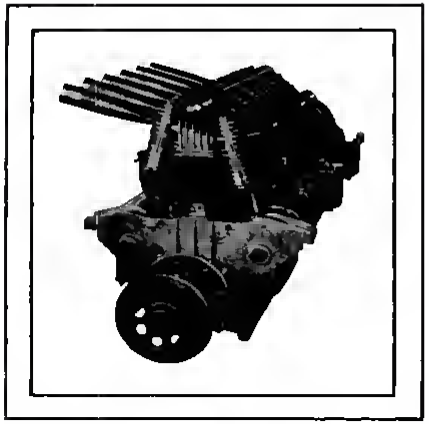
From all these points the National Air Transport can today make swift connection with sister air-lines flying to all important centers west of the Mississippi. You can now fly by National Air Transport, without stop-overs, from the Atlantic to the Pacific in 31 hours; and from the Pacific to the Atlantic in 28 hours.

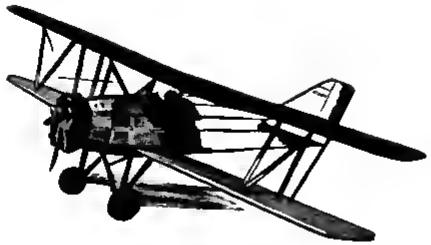
Five years' experience in transport flying and eleven million miles of successful operation are the foundation of this necessary transportation service.

Of course, Ford all-metal, tri-motored commercial transports form an important part of the National Air Transport fleet. For Ford planes are in demand wherever the American public has learned to accept aviation as a commercial factor of importance.

Last year alone Ford planes flew 8,000,000 miles!

FORD MOTOR COMPANY





AN

EXPERIMENTAL

ENGINE

BUILT *Complete by* GOVRO-NELSON

THE VANG air cooled engine built complete in the Govro-Nelson shops is a typical example of the Govro-Nelson method of developing an experimental engine. So precisely and accurately is the machining and assembling done that only the most experienced eye could tell it from a production job.

Characteristic of Govro-Nelson engine production are the Aeronca E-107A and E-113—two-cylinder opposed, air-cooled engines developing 30 and 40 horsepower that are daily winning public regard for the Aeronca and other light planes by dependable performance.

Such achievements are not the haphazard results of chance, but the direct effect of a vast engineering background and experience, extending to the inception of the industry, plus a shop well equipped with efficient production machines, precise testing equipment and a corps of workmen skilled through years of service to the aviation industry, with a fine concern for a prized reputation for correctness in design and accuracy in manufacture.

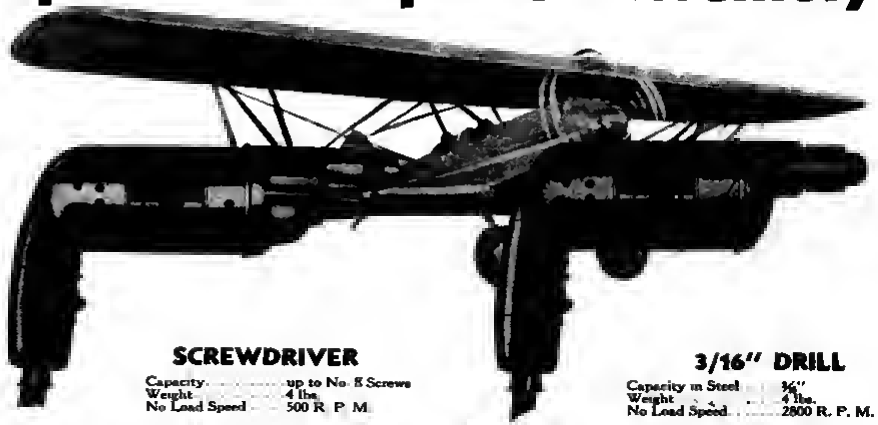
The Govro-Nelson service includes the design of engines and engine parts, the building of experimental engines, the machining of engine parts and the production of engines. Govro-Nelson engineers will gladly cooperate with you in solving your design or production problems. Write us today.

THE GOVRO-NELSON COMPANY

1931 ANTOINETTE DETROIT

CRAFTSMEN TO THE AVIATION INDUSTRY

The New High Cycle Twins for Speed in Airplane Assembly



SCREWDRIVER

Capacity ..... up to No. 8 Screws
Weight ..... 4 lbs.
No Load Speed ..... 500 R. P. M.

3/16" DRILL

Capacity in Steel ..... 3/16"
Weight ..... 4 lbs.
No Load Speed ..... 2800 R. P. M.

SMALL in size, light in weight, powerful in operation, the new Black & Decker-Van Dorn High Cycle Twins are designed to do their work with great ease and speed, even in close quarters. Small body diameters and rounded exterior surfaces fit the tools to the hand and afford the operator easy grasp in any position. With them your operators can do more work, in less time, at less cost.

The High Cycle Screwdriver has an adjustable friction clutch which drives the screw "flush" and releases immediately without danger of marring the screwhead or surrounding surface. Driving teasing can be conveniently set with the knurled thumb screw on the gear case. When necessary, the bit can be given an extra turn by a mere pressure of the finger on the clutch control. In addition, this screwdriver has a positive clutch which allows the spindle to remain idle for finding slot in screw, and immediately engages the bit when pressure is exerted. This new unit is ideal for the many light screwdriving applications in airplane assembly work.

The drill is fitted with a 3/16" key operated chuck with key, and a 4 conductor cable without plug. Like its companion, the screwdriver, it has all the features found in the other tools of the High Cycle line including the new squirrel-cage type motor, with welded copper bar rotor, operating on 180 cycle current. This drill is particularly applicable to the requirements of the aeronautical industry.

If you are using ten or more Portable Electric Tools let one of our sales engineers show you how readily an installation of High Cycle Tools may be made in your plant, and why they will produce more work in a given time than universal motored tools. Or mail the coupon below for our catalog describing the complete Black & Decker-Van Dorn High Cycle line

BL... RN
SUP... OLS

The Black & Decker Mfg. Co.
The Van Dorn Electric Tool Co.
TOWSON, MD. U. S. A.

Slough, Bucks., England Toronto, Ontario, Canada
Sydney, Australia

BLACK & DECKER - VAN DORN
Towson, Maryland

Please send me your newly published catalogue describing the complete line of Black & Decker-Van Dorn High Cycle Tools.

Firm .....
Name .....
Address .....

ALMOST TWICE AROUND THE GLOBE AT OVER 3 MILES A MINUTE!

PUSHED to a height of over four miles by the jagged Alps, blasted by bad winds and weather along the way, Captain Frank Hawks has shown what he and a Wright engine can do by setting new records in his Travel Air!

In his first European flights he cut the time from London to Rome in less than half, and from Paris to London he flew in less than a single hour. These trips give the "Texaco 13" pilot a list of records equaled by no other in the world—records that mean something!

And the log of Captain Hawks shows a distance of more than 40,000 miles spanned at an average of 3 miles a minute—*behind the same "Whirlwind 300"!*

Yet, as Hawks explains it, these flights aren't feats. They are records made at his ship's normal speed . . . records, as he modestly puts it, actually won at the factory before he took the air!

Frank Hawks is not a wild stunt flyer. He flies faster than others because his Travel Air racer and his E-type "Whirlwind 300" are so improved in structure and power that his normal, unstrained cruising speed is enough to beat other ships flying at top speed.

That's what you get when you buy an engine by Wright—power enough to win world records. For every standard "Whirlwind 300" off the production line is the same in every improvement as the engine that Frank Hawks flies!

WRIGHT

AERONAUTICAL CORPORATION

PATERSON, NEW JERSEY

A DIVISION OF CURTISS-WRIGHT CORPORATION

B. G. MICA AVIATION SPARK PLUGS

(Patented in the United States and Other Countries)

B. G. Hornet Spark Plugs

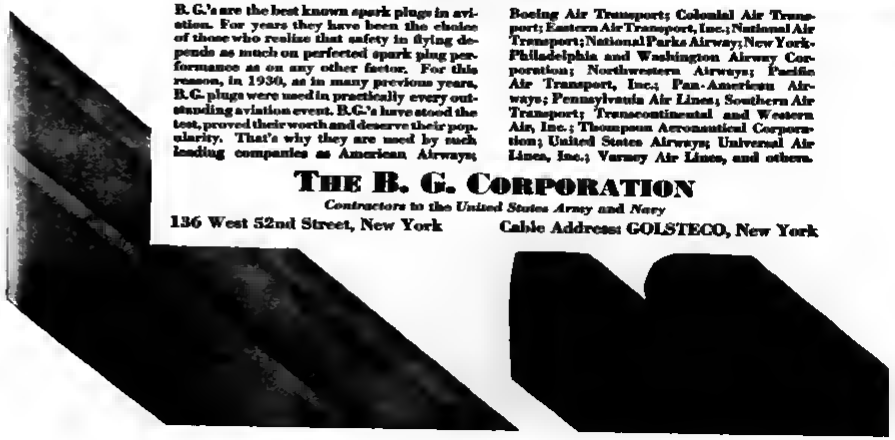
These is a B.G. Hornet Spark Plug to fit every make of air-cooled and water-cooled engine. The latest plugs are the 3B-1; 4B-1; and 5B-1 models. These cover the entire range of operation from the highly super-charged engines to cold weather idling conditions in standard engines. The improved design and construction of each of these plugs gives increased electrode life and enlarges the range of operation.

B. G. 1XA and 1XB Spark Plugs

There are four different types of B. G. Spark Plugs with one inch hex. They are the 1XA Regular; 1XA Extra Gap; 1XB Regular; and 1XB Extra Gap. These plugs are used with unusual success in almost all standard types of engines. The Extra Gap models are the same as the Regular models except for the extra gap which is built into the terminals. The Extra Gap type is preferred by many users because there is greater resistance to fouling under certain excessive oil conditions.

The Choice of Those Who Know

B. G.'s are the best known spark plugs in aviation. For years they have been the choice of those who realize that safety in flying depends as much on perfected spark plug performance as on any other factor. For this reason, in 1930, as in many previous years, B.G. plugs were used in practically every outstanding aviation event. B.G.'s have stood the test, proved their worth and deserve their popularity. That's why they are used by such leading companies as American Airways; Boeing Air Transport; Colonial Air Transport; Eastern Air Transport, Inc.; National Air Transport; National Parks Airway; New York-Philadelphia and Washington Airway Corporation; Northwestern Airways; Pacific Air Transport, Inc.; Pan-American Airways; Pennsylvania Air Lines; Southern Air Transport; Transcontinental and Western Air, Inc.; Thompson Aeronautical Corporation; United States Airways; Universal Air Lines, Inc.; Varney Air Lines, and others.



THE B. G. CORPORATION

Contractors to the United States Army and Navy

136 West 52nd Street, New York — Cable Address: GOLSTECO, New York

No. 9 of a series of advertisements on "How Superlative Quality is Built into Roebling Wire Rope"

Painstaking Care is the Watchword

When it comes to making wire of exceptionally great strength and stamina, such as required for Roebling Aircraft Wire, Strand and Cord, ordinary production methods won't do. Skill of the higbest order is called for. Painstaking care must be the watchword.

So, in this Roebling patenting shop, the most exacting of standards prevail. Years of experience govern every move and haste is outlawed. Furnace temperatures, the rate at which the wire travels through the furnaces—all elements of the patenting process—bave been establisbed through decades of research and development.

Patenting, at Roebling, is a highly developed art—one that contributes much to the great strength and stamina for which Roebling Wire Aircraft Products are noted. Incidentally, the Roebling patenting shop is one of the largest and most modern of its kind in the country.

JOHN A. ROEBLING'S SONS COMPANY

WIRE | WIRE ROPE | WELDING WIRE | FLAT WIRE COPPER *and* INSULATED WIRES AND CABLES WIRE CLOTH *and* WIRE NETTING — *Export Dept., New York*

TRENTON, N. J. *Branches in Principal Cities*

ROEBLING WIRE AIRCRAFT PRODUCTS

EDO FLOATS

FLY ON FLOATS THIS SUMMER

SECLUDED pine-bordered lokes... golden beaches by the sea... yocht clubs where sportsmen gother ... summer resorts on Inlond waterways ... docks close beneath towering office buildings ... link them oll for business or pleasure with EDO Floats.

If you own o plone or plan to purchase—floats will double its usefulness ond range of service. EDO equipment is not o compromise. Quickly interchongeable with wheel londing geor, it affords you the best for either type of flying—sacrificing nothing of speed, maneuverability, airworthiness.

EDO oll-metal Floats represent the highest degree of skill and experience in float design ond construction. They ore promptly availoble in 15 stondord sizes. Practically every well-known moke of airplane—40 distinct types—are licensed on EDO Float installations. Let us give you complete information regarding EDO equipment for your plone. Address, EDO Aircraft Corporation, 600 Second Street, College Point, Long Island, N.Y.

NOW—

AUTOMATIC WATER RUDDERS FOR EDO FLOATS

At the left is shown a view of the production line in the Blade Department of Hamilton Standard. At the right: reproduction of photograph, showing grain flow in a blade forging.

PROPELLER BLADES OF . . .

PROVEN DEPENDABILITY

The *dependability* of Hamilton Standard propeller blades is based quite as much upon blade forgings of the highest possible characteristics, as upon correct design and careful workmanship.

The photograph reproduced above illustrates the high state of forging technique represented in the forgings supplied currently by the Aluminum Company of America. The excellent grain flow shown has been developed to strengthen the forging at the point where the vital blade root shoulders are formed. This provides maximum resistance to the tremendous shear, bending and fatigue stresses placed upon them when in flight.

This is only one of the many fundamentally important developments which have contributed materially to the established *dependability* of Hamilton Standard propeller blades.

HAMILTON STANDARD PROPELLER CORPORATION

PITTSBURGH, PENNSYLVANIA

DIVISION OF UNITED AIRCRAFT AND TRANSPORT CORPORATION

FAMOUS FLIGHTS WITH THOMPSON VALVES

WHEN *Kingsford · Smith*

MADE THE ATLANTIC A TWO-WAY THOROUGHFARE

Fighting a gallant battle against storm and fog, the veteran Fokker monoplane "Southern Cross," piloted by Wing Commander Charles Kingsford-Smith, landed safely at Harbor Grace, Newfoundland, on the dawn of June 25, 1930, completing the first successful east-west Atlantic crossing in a heavier-than-air craft. The start of this epic flight was Portmarnock, Ireland. The time, despite that lost through blind groping along the fog-bound coast, was 31 hours and 26 minutes.

Throughout this time, the three Wright "Whirlwind" motors on which Kingsford-Smith and his three companions relied, never faltered in their duty. And as on previous occasions when this same ship and pilot made aircraft history — notably in the sensational 8700-mile flight from California to Australia in 1928 — the motors of the "Southern Cross" were again equipped with Thompson Valves.

THOMPSON PRODUCTS, INCORPORATED

General Offices: Cleveland, Ohio, U. S. A.
Factories: CLEVELAND and DETROIT

This advertisement is one of a series recording famous flights in which Thompson Valves were used.

Thompson Valves

BEAUTIFUL, SAFE, COMFORTABLE

SPEED WITH EASE FOR FOUR

CURTISS-WRIGHT

SEDAN

To the sportsman, business executive and light transport operator alike, Curtiss-Wright offers the 4-place SEDAN, a distinctly new conception in light cabin planes. ● The beauty of its lines and the pleasing effect of harmonious colors make an immediate appeal to the man who takes pride in the possession of any fine article. ● And this first impression is heightened by a glimpse of the cabin interior. Rich in its appointments, luxuriously upholstered with fine fabrics and deeply cushioned seats, the spacious cabin of the SEDAN invites you through a generously wide door to the comfortable relaxation of many a pleasurable jaunt cross-country . . . . anywhere, anytime. ● Vision, that most important factor in safe, carefree flights, has been given special consideration. On the ground or in the air, the pilot looks out over a smoothly cowled engine which permits the same clear view one finds in a good motor car. Wide, adjustable side windows complete the fine range of vision, since they are unobstructed by the customary outrigger struts. ● And you will delight in the surprising performance of the SEDAN. Clean-cut lines and a new design wing curve, coupled with rugged, dependable power, assure the utmost in performance . . . . take off quickly, climb thousands of feet in a few short minutes, speed at two miles a minute and better if you like, then swing back to earth for an easy, slow landing . . . and thru it all the almost effortless control which comes with perfect balance and ballbearing controls. ● Know the real joy of flying. See your Curtiss-Wright dealer and arrange for a demonstration in the SEDAN. ● OTHER CURTISS-WRIGHT MODELS . . . . 2-pl. Junior . . . . 2-pl. Sport Trainer . . . . 3-pl. Sportsman deluxe . . . . 2-pl. Coupe . . . . 6-pl. Travel Air . . . . 8-pl. Kingbird.

CURTISS-WRIGHT

AIRPLANE COMPANY

ROBERTSON, MISSOURI

(A DIVISION OF CURTISS-WRIGHT CORPORATION)

ADVERSE weather may suddenly overtake the airplane thus obscuring the natural horizon. Under these conditions, determination of the plane's attitude from interpretation of the usual instruments becomes extremely difficult. Loss of control may result.

The Sperry Horizon, a gyroscopic instrument, defines the exact position of the natural horizon, making flying in fog, clouds, or darkness, simple and safe.

Over 300 Horizons in service.

SPERRY GYROSCOPE CO., *Inc.*

BROOKLYN — NEW YORK

Service — one of the "invisibles" that makes WACO Value

* * *

The complete WACO line ranges from $4,450 to $8,525, with Heywood starters standard equipment on all models. Deferred payments can be arranged. And purchase of a new WACO includes any needed instruction. See your distributor for details.

* * *

***In This Case . . . 70 MINUTES!**

Wire from a Vermont representative for wing and 5 other items, received ..... *10:20 A. M.*
Wing boxed, other parts packed, and Express Company receipt signed at ..... *11:21 A. M.*
Entire shipment left Troy on train ..... *11:50 A. M.*
A typical example of WACO Service?
Exceptional? Well, perhaps...but certainly significant.

There comes a time in the career of every flyer . . . and in the course of every airplane's life . . . when that element called "Service" becomes the *one* important thing in the world to pilot and plane. ● Yet if that pilot happens to be one of the thousands who fly WACOs, service of any sort is within a short hop from wherever he is at the moment. It becomes an incident and not an exasperation. For, nearly 300 WACO representatives dot the map like buckshot blown from a blunderbuss. And 55 WACO distributors provide organized service facilities for all common replacement parts. ● In the less common contingencies, the factory can supply any part for *any* WACO ever built . . . and prides itself that this can be done within any 24 hours!* ● Ask any owner what WACO means by Service. It has much to do with WACO leadership in the number of registered aircraft . . . more than any other American make. It is the kind of service *you* can depend upon . . . and some day will want. It is not included in the specifications or in the purchase price . . . but *don't* overlook it in making your selection.

THE WACO AIRCRAFT COMPANY, TROY, OHIO

WACO AIRPLANES
"ASK ANY PILOT"

THERE ARE MORE WACOS IN PRIVATE AND COMMERCIAL USE THAN ANY OTHER AMERICAN MAKE

In this *FREE BOOK* . . . Scientists tell which fastening device holds best!

FOR weeks scientists of the College of Engineering, New York University, tested the holding power of fastening devices to determine whether Self-tapping Screws, noted for economy in assembly work, have greater or less holding power than the fastening devices they usually replace.

The investigation was unbiased and thorough. It developed much new data on the holding power of fastening devices under tension, shear and vibration stresses. All of the information is given in the free booklet offered here. It is illustrated with photographs and charts; and also gives a scientific explanation of why fastenings made with Self-tapping Screws are more secure.

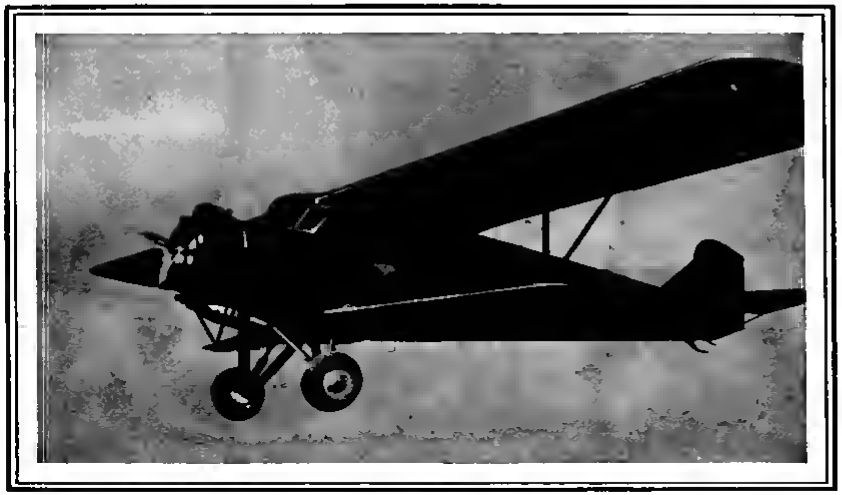
Every design and production man will find this book interesting and informative. Simply mail the coupon below. With it we will send, free, another valuable booklet which shows how leaders in the metal working industry are effecting important savings in the assembly of their products.

PARKER-KALON *Hardened* Self-tapping Screws

PAT. IN U. S. AND FOREIGN COUNTRIES

PARKON-KALON CORPORATION, Dept. M., 192-200 Varick Street, New York, N. Y.
Send me the free Security Booklet. Also free book of assembly economies.
Name and Co.....
Address.....

OVER THE MOUNTAIN TOPS—WITH THE ENGINE ACTUALLY GAINING "REVS"!



THE performance of the Packard-Diesel at high altitudes has amazed the aviation world! When flying over mountains pilots expect the engine R. P. M. to decrease—but they have found that this is not the case with the Packard-Diesel.

Recently, while climbing to cross the Rockies in a Packard-Diesel powered plane the pilot kept close watch of the tachometer. At 6,200 ft. the engine had gained 50 revolutions per minute—without the throttle being touched. At 10,000 ft., with the throttle still unchanged from a setting for a normal cruising speed of 1700 R. P. M., the tachometer read 1800—a gain of 100 "revs"!

This is but typical of the altitude performance of the Packard-Diesel. Tests have further shown that the 225 H. P. Packard-Diesel is equivalent to a 350 H. P. gasoline engine at 20,000 ft. altitude. This is because the Packard-Diesel automatically adjusts itself to altitude with a resultant efficiency of operation which cannot be duplicated in any engine which requires manual adjustment for this ever-changing condition of flight.

The relatively constant efficiency of the Packard-Diesel thus permits a much higher absolute ceiling and hence operations of high altitudes without a radical decrease in speed. These advantages plus many more inherent in the Packard-Diesel have been responsible for its world-wide acceptance. Today the Packard-Diesel is everywhere recognized and acclaimed!

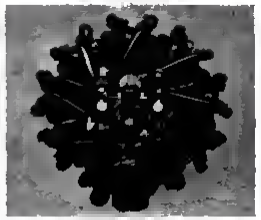
PACKARD MOTOR CAR COMPANY
DETROIT, MICHIGAN

PACKARD-DIESEL

ASK THE MAN WHO OWNS ONE

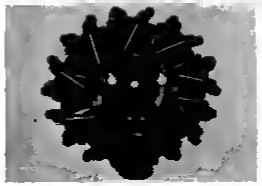
SKY SERVICE

HEYWOOD STARTER

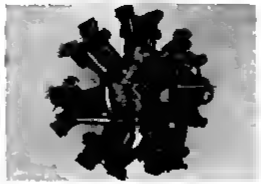


Rear View of the "Cyclone" 575 H. P. showing Heywood Starter installation.

receives the full approval of Wright Aeronautical Corporation



Rear View of the "Cyclone" 525 H. P. showing Heywood Starter installation.



Rear View of the "Whirlwind" 240 H. P. showing Heywood Starter installation.

Rear View of the "Whirlwind" 165 H. P. showing Heywood Starter installation.

THE above caption is a statement of great importance and of far reaching consequence to owners and operators of the famous Curtiss-Wright Engines. For now the Heywood Starter is optional equipment on the following models:

- Curtiss V-1570 Conqueror—V Type, 12 cylinder, watercooled, 600 H. P.
- Curtiss D12 Conqueror—V Type, 435 H. P.
- Cyclone—Nine cylinder, radial, aircooled, 575 H. P.
- Cyclone—Nine cylinder, radial, aircooled, 525 H. P.
- Whirlwind "E"—Nine cylinder, radial, aircooled, 400 H. P.
- Whirlwind—Seven cylinder, radial, aircooled 240 H. P.
- Whirlwind—Five cylinder, radial, aircooled 165 H. P.
- Wright Gypsy—Four cylinder in line, aircooled, 90 H. P.
- Challenger—Six cylinder, radial, aircooled, 185 H. P.

Write for details and installation diagrams.

SKY SPECIALTIES CORPORATION
3651 HART AVENUE - DETROIT, MICHIGAN

START-ER
HEYWOOD

427 Hours
of Continental Performance

The Result of Continental Precision

The greatest proof of precision building is in actual performance. Not block tests—not dynamometer tests—but the burden of actual service under varying conditions and climates — under varying loads and even overloading — in desert sand — heat and high altitudes.

The following letters graphically illustrate the tremendous stamina that is built into Continental Aircraft engines. The first letter, dated January 2, 1931, was written at the time of purchase of Continental A 70 series number 117.

"We have just purchased a plane powered with Continental A 70 engine serial number 117. This motor, to date, has been in service a little over 300 hours and to our knowledge the only service has been the grinding of valves on three of the cylinders. We believe it one of the best we ever had any experience with"

By H. P. JOYCE, Proprietor
Roswell Air Service Inc.
Roswell, New Mexico

The following letter, written by J. C. Barnett, chief pilot of the Roswell Air Service, dated May 13, refers to the same engine

"As to detailed performance—the top speed is 112 to 115 miles per hour. The cruising speed is 100 to 105. The climb about 750 feet p. m. The cruising radius 6 hours plus. As to engine performance—it has been exceptionally good. At present the engine has 427 hours and 30 minutes with one valve grind and one set of rings installed. The engine is turning very close to top and is using very little oil."

J. C. BARNETT, Chief Pilot

No greater proof of precision building and stamina could be shown than the above performance after 427 hours of active, hard service.

Continental A 70 Second Series 7 cylinder Radial Engine. 165 h. p. at 2000 r. p. m.

Continental A 40 4 cylinder Light Aircraft Engine. 38 h. p. at 2550 r. p. m. ATC 72

CONTINENTAL AIRCRAFT ENGINE COMPANY
General Office and Factory, Detroit, Michigan

Continental
for the Airways of America

"SEEING" THROUGH FOG

5,000 FEET THICK

Here's a battery that was made to fly. This Exide Aircraft Battery is light-weight—compact—safe.

Dependable Exides keep radio communication alive—make for safe landings

"YOU'RE over hangar five," reports the voice from the ground. And the pilot spirals down through the fog with confidence. A few minutes later—happy landing.

Exide Aircraft Batteries help make radio communication certain. And they supply steady power for landing, navigation and instrument lights—starting and ignition. Exides are designed for minimum weight. They assure absolute dependability. Moreover, the electrolyte will not spill.

Ask any pilot about Exide reliability. Write today for further information. One-seater "mono" or transcontinental air liner—there's an Exide Aircraft Battery to fill the bill.

Exide
AIRCRAFT
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia
THE WORLD'S LARGEST MANUFACTURERS OF STORAGE BATTERIES FOR EVERY PURPOSE
Exide Batteries of Canada, Limited, Toronto

ENGINEERING SERVICE

born of Aviation's Needs

HELPFUL cooperstion with aircraft engineers in designing and furnishing *useful* ball bearings (not just any ball bearing) for control systems, demanded e clear understanding of airplane design and production methods. Such an understanding Fefnir has acquired through actual contact, et first hand, with the problems of producing friction-free, service-free, trouble-free control systems.

Illustrative of one of the bearings developed is the Fefnir Single Row Ball Bearing Certridge ehown above. This unit eliminetes the expense and trouble of designing end making special seals. It provides an accurate closure for the hall bearing, reduces weight and protects the bearings in assemhly and disassembly Thie cartridge unit ie *outstanding for controls* under any conditions of exposure.

And thie ie but one of the designs which Fefnir engineers have developed in conjunction with aircraft engineers and designers. Integral double eeal bearings, torque tube bearings, an inch dimension serise, and other epecial types are described in Fafnir Aircraft Data Sheets. Write for copies.

LEADING USERS OF THE FAFNIR BALL BEARING CARTRIDGE INCLUDE:

American Airplane & Engineering Co.
Boeing
Chance-Vought
Consolidated
Curtiss
Fokker
Glenn Martin
Northrop
Pitcairn
Spartan
Stearman

THE FAFNIR BEARING COMPANY
NEW BRITAIN, CONNECTICUT

Atlanta Chicago Cincinnati Cleveland Dallas Detroit
Los Angeles Milwaukee Newark New York Philadelphia

FAFNIR BALL BEARINGS

Destined for Leadership

the new, single engine, ten place

PILGRIM MODEL 100

TRANSPORT AIRPLANE

and the

RANGER 6-390

SIX CYLINDER, INVERTED, IN LINE, AIR COOLED ENGINE

These products offer to the industry new standards of design and manufacture made possible through a continuation of the craftsmanship of the former Fairchild Airplane Manufacturing Corporation and Fairchild Engine Corporation—with added resources and facilities.

AMERICAN AIRPLANE & ENGINE CORPORATION

Manufacturing Division of The Aviation Corporation

FARMINGDALE, L. I. NEW YORK

We have for sale several slightly used factory demonstrators in all types of FAIRCHILD open cockpit biplanes and closed cabin monoplanes, in excellent condition at most attractive prices

FULL INFORMATION ON REQUEST

BELL TELEPHONE LABORATORIES' TRI-MOTOR PLANE NC-417H uses WESTON TACHOMETERS

Model 545 INDICATOR—Mounted in a standard aircraft case used with instruments of the 3-inch group. Furnished with black dial with luminous markings and pointer.

● Weston Tachometers, because of their constant dependable operation and unique constructional features, are meeting with enthusiastic acceptance by aeronautical authorities and pilots.

With Weston Tachometers, engine-speeds are brought directly before the pilot on the cockpit panel.

The Weston Tachometer has no troublesome flexible drive shaft. It operates electrically. It consists of but two units: a light, compact D. C. magneto-generator, and an indicator. The magneto, which mounts directly on the SAE tachometer outlet on the engine, is connected to the indicator by a pair of wires. Rugged and compact, Weston Tachometers are setting a new standard for convenient, dependable, trouble-free engine-speed indication that is a practical necessity to safe and intelligent flying.

Model 544 MAGNETO-GENERATOR—Small and compact; weighs only 1 pound, 5 ounces. Generates a voltage, directly proportional to driven speed, which is carried by wires to indicator on cockpit panel.

Features of Weston Tachometers

1 Accurate, steady, dependable indications.

2 Light weight.

3 Simplicity and ease of installation

4 Practical freedom from all maintenance.

5 Complete elimination of troublesome, flexible drive shafts.

6 Unaffected by temperature changes.

7 Indicators give 270° deflection over 5½-inch scale.

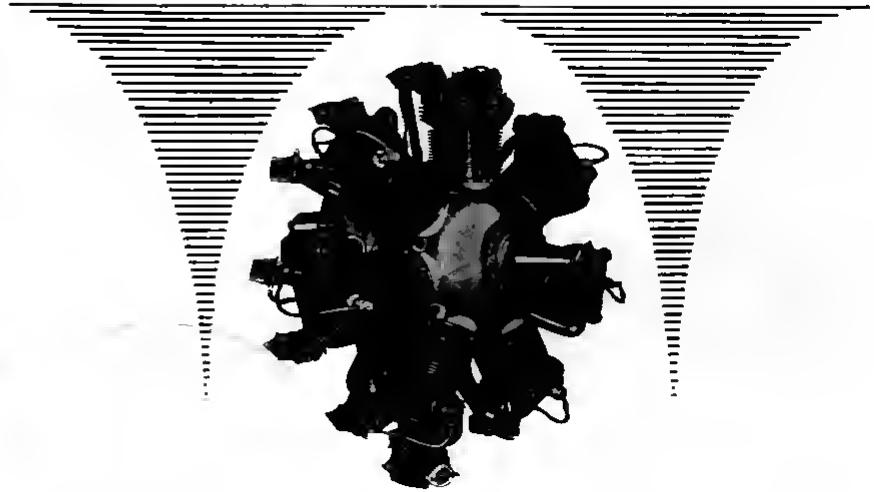
8 Indications unaffected by banking, etc.

9 Fully shielded to prevent interference with magnetic compass or radio.

WRITE FOR DETAILS

WESTON Electrical Instrument Corporation

616 Frelinghuysen Avenue **Newark, N. J.**



Keeping Step with Progress

The world moves—and so he who does not move with it must be left behind.

Nowhere is this progress more apparent than in the Aircraft Industry, where barriers of old and hoary precedents from the past, form no bar to the advance of the adventurous and the daring. There are no impediments to a free and open mind in this industry.

Thus Warner engineers and Warner designers are ever on the alert—ever keeping step with progress—to the end that the Warner Engine will embody always the latest improvements and advancements.

It is a never-ending task—but a stimulating one—this search for new ideas—new methods. It is this constant striving after the new and the better, that keeps the Warner Engine always as new as each new day.

WARNER AIRCRAFT CORPORATION
DETROIT, MICHIGAN

WARNER "Scarab" ENGINES

THIS ultra-modern airplane startled everyone attending the Detroit Show by its performance... Cruising from Los Angeles to Detroit at 142 m.p.h., consuming eight gallons of gasoline per hour at this speed and using two quarts of oil for the trip... such performance is possible only with an engine that takes advantage of the foremost principles of inline, ieverted coestruction.

THE MENASCO BUCCANEER

160 H.P. at 1975 R.P.M.

MENASCO MOTORS, INC · · · 6718 McKinley Avenue · · · Los Angeles, California · U. S. A.

A Good Investment

for Business or Pleasure

LOWEST PRICED AMPHIBION IN THE WORLD

$5,800...

PRIVATEER!

PRIVATEER'S economy of operation and remarkably low price of $5,800—several thousand dollars lower than that of any other amphibion in the world—mark it as an outstanding investment for the three great air-minded classes, flying schools, salesmen and sportsmen.

Rugged of construction . . . smart in appearance . . . the two-place open cockpit monoplane PRIVATEER [A. T. C. 370] is designed and manufactured by pioneer makers of amphibions. In stiff tests it has shown unusual stability, ease of control and maneuverability . . . and its adaptability to landing condition—snow, ice, rough terrain and water considered—has amazed experienced pilots. Flying range adequate for all reasonable needs . . motor parts extremely easy of access.

A dependable Warner "Scarab" motor of 110 h. p. provides a high speed of 93 miles per hour . . . a cruising speed of 75 . . . a landing speed of 41 . . . a climb of 650 feet per minute . . a cruising range of 250 miles. All this with a useful load of 600 lbs.—performance aplenty

Naturally, because it is ideally suited for the use of the three great air-minded classes, dealers who sell the PRIVATEER have entry into a vast market. Just as the purchase of a PRIVATEER is a good investment for its owner, so is a territorial appointment for distribution . . . for Amphibions, Inc. dealer policy provides a liberal profit on each sale.

For complete information concerning the territorial appointments that are now being made, write or wire

PRIVATEER
$5,800 (Fly-away at Factory)
A. T. C. 370
Weight Empty, 1350 lbs.
Gross Weight, 1950 lbs
Standard Equipment
Warner "Scarab" 110 h. p.
Paragon Pusher Propeller
Heywood Injection Starter
Low Pressure Tires
Fuel Level Gauge
Tachometer
Oil Thermometer
Air Speed Indicator
Altimeter, Tools, Anchor
Rope, Cockpit Cover
Fire Extinguisher

AMPHIBIONS, INC.

GARDEN CITY NEW YORK

STRENGTH in your Tubing

means

STRENGTH in your Airplane

SERVICE STEEL CO.

19 SCOTT ST. BUFFALO
22 E. FRONT ST. CINCINNATI
1400 FRANKLIN ST. DETROIT
210 N. ALEMADA ST. LOS ANGELES

ALPHABETICAL INDEX

This index is published as a convenience to the reader. Every care is taken to make it accurate, but Aviation assumes no responsibility for errors or omissions.

Searchlight

Classified Advertising

Aircraft Service Directory

Professional Services

Where to Fly

Aircraft Service Directory

Check these columns regularly for the equipment you need. If you don't find what you want—advertise for it.

6-5

Professional Services

The OUTSIDE VIEWPOINT IS VALUABLE

The consultants represented in this section are equipped to solve your problems. When a difficult problem confronts YOU do not fail to take advantage of the value of the outside viewpoint these consultants are prepared to render.

CONSULT THIS SECTION

WHERE TO FLY

CALIFORNIA

IOWA

ILLINOIS

INDIANA

NEW YORK CITY

The first step in learning to fly is to select the right school. Let the "Where To Fly" section of Aviation help you.

NEW YORK CITY

MISSOURI

WISCONSIN

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or SPECIAL

UNDISPLAYED—RATE PER WORD

Positions Wanted, 10 cents a word, minimum $2.00 an insertion, payable in advance

Positions Vacant and all other classifications, including equipment, 15 cents a word, minimum charge, $3.00 an insertion

Proposal 45 cents a line an insertion

INFORMATION

Box Numbers in care of our New York, Chicago or San Francisco offices count 10 words additional to undisplayed ads.

Discount of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals)

DISPLAYED—RATE PER INCH

1 inch $6.00
2 inches .... 5.75 an inch
4 inches .... 5.50 an inch

Other spaces and contract rates on request

An advertising inch is measured vertically on one column 3 columns—30 inches—to a page

COPY FOR NEW ADVERTISEMENTS RECEIVED UNTIL THE 15th FOR ISSUE OF FOLLOWING MONTH — Aviation

POSITIONS VACANT

PROMINENT aircraft manufacturer immediately requires a capable energetic pilot sales representative to demonstrate and sell and to appoint dealers in Eastern states. Submit photograph, complete experience, remuneration expected and references. P-96, Aviation, Tenth Ave. at 36th St., New York

TECHNICALLY trained airplane designer and engineer. Must have both theoretical and practical experience. Men of highest qualifications and best character references, only, considered. Give all details in application. P-97, Aviation, Tenth Ave. at 36th St., New York

POSITIONS WANTED

EX-ARMY man and commercial mechanics school graduate, eligible for mechanic's license. Sober and industrious. Willing to go anywhere. Age 22 and single. Address P O Box 271, Winnsboro, S C

L C PILOT, Curtiss-Wright trained, age 25, good references, will go anywhere. Wages secondary, private owner connection preferred. O. Campbell, 1092 Linden Ave., Memphis, Tenn

PILOT twenty two hundred hours, five hundred hours first pilot Fokker tri-motors. Best references. PW-82, Aviation, 883 Mission St., San Francisco, Cal

SALES manager available, now employed by airplane manufacturer, but foreign control hinders progress. Have made specialty of flying boats and amphibians. Private commercial and government contacts. Mechanical engineer, 36 years old. PW-83, Aviation, Tenth Ave. at 36th St., New York

SALE $8,000, Wasp Ireland amphibian, excellent condition, one hundred hours since factory overhaul. Location New York City. PW-84, Aviation, Tenth Ave. at 36th St., New York

WANT work and chance to learn flying under person interested in an eighteen, high school graduate, recommendations if desired. Howard Pidgeon, Wilmington, Ohio.

BUSINESS OPPORTUNITIES

CORPORATE organizing and financing. Brookworth, 110 East 42nd St., New York

FOR SALE

BIRD (OX-5) over $700 worth of extras, including Scintilla magneto, Hamilton steel propeller and 28 ft. Irvin chute, newly painted, complete overhaul of motor and ship, total time 95 hours. Best offer over $1,200 takes all. Owner buying autogiro. Harold Shalett, Waterbury, Conn.

BRAND new Curtiss Wright Junior. Has less than ten hours. Is stored in hangar of Curtiss Flying Service, Miami, Fla. Price, $1,050. Radiant Oil Company, Seventy-Third Street and Tenth Avenue Northwest, Miami, Fla.

BRAND new, while they last, OX-5 and OXX-6 American Eagle airplanes, $1,485. Waco ten, reconditioned, like new, $905. Other real buys. Automobiles taken in trade. Blosser Motor Company, Concordia, Kansas

FOR SALE. New inverted in-line Argus engine, four cylinder, air-cooled, 90 hp. 1930 model A90. The foremost European light engine. Brand new, in crate, $750. Menasco Motors, Inc., 6718 McKinley Ave., Los Angeles, Calif.

AVIATION STUDENTS
How to get the most ground or flight training for your money is explained in our new bulletin—FACTS EVERY PROSPECTIVE AVIATION STUDENT SHOULD KNOW. Discusses frankly all methods of learning to fly and various ground courses, your chances of making good in this fascinating industry and many other interesting facts. Save dollars. Send coupon for $1.00. Write for free circular.
Aviation Information Service, Box 1221, Washington, D.C.

FOR SALE

FOR SALE. Savoia Marchetti, 3-place S56 amphibian. Flown about 200 hours. Just completely overhauled. Asking $3,600 but will consider reasonable cash offer. R W A Bowles, 2800 Prairie Ave., Chicago, Ill.

FOR SALE. OX Challenger 3-place Biplane. License No NC 7030. Licensed till December 1931, new motor and new Scintilla magneto. Special $895. Westchester Airport Corp., Armonk, N Y

FOR SALE. Single seat monoplane (uncomplete), also rebuilt Lawrence motor (two cylinder) with two throw crankshaft connecting rods pistons roller bearing and magneto. Price reasonable. Walden Claglo, 75 Franklin Ave., Hartford, Conn

FOR SALE or trade. Hisso 180 Eaglerock 23 like new. Had about 180 hours. Complete overhaul. Bronze valve seat and Tompson valves. Never cracked. A C Burdick, Turtlepoint, Pa.

FOR SALE. Heath Parasol with pontoons, wheels or both. Harley Davidson motor. Will demonstrate. Photos upon request. M J Yacobice, Crisfield, Md

FOR SALE. Wright J-6 R engine, complete with Eclipse Booster Starter, major overhauled and run in, total time 287 hours. First $700 takes it. S. G Shore, 311 Westmoreland Avenue, Lansing, Michigan

FOR SALE. Combination Wing OX5 Eaglerock. Ship newly covered and painted and in perfect condition. Motor turns 1,500. Cash sale, $600. Would consider late model automobile in trade. Sellers Garage, Champaign, Illinois.

FOR SALE. Model F Warner powered Waco, 43 flying hours. Private owner. Always hangared. Equipment steel propeller, airspeed and compass. Purchased August, 1930. Priced to sell. L M Richards, Pottsville, Pa.

FOR SALE or trade. New Wright J-6-5 Curtiss Robin, special Berryloid finish, cabin heater, dual controls, very complete, licensed. Will trade for good used Model F Waco, 5-place New Standard, or automobiles. Write for cash price. Allton Flying Service, Columbia, Mo

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FOR SALE. Fairchild FC2W2, 7-place Wasp. Sea condition. Licensed to December 1931. Total engine hours 650, landing lights, bank and turn, etc., west buy in country, $3,000 cash, or will assist in financing. No trades. Chicago-Detroit Airways, 5032 W 63rd St., Chicago, Ill.

FOR SALE. Stinson Jr. Wright J-5. Motor completely overhauled. New valve seats, new valves and guides. New main bearings. New rings. Heywood starter. Bank and turn indicator. Air wheels and tail wheel. Ship and motor like new. First $3,000 takes it. NC8427. Shattuck Auto Co., Owosso, Michigan

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